FUSCOE ENGINEERING

# Sewer Impact Study

## DEL AMO FINANCIAL CENTER

*Torrance, California*
*Hawthorne Blvd & Carson St*

Prepared For

*The Muller Company*
*18881 Von Karman Avenue, Suite 400 Irvine, CA 92612*

Prepared By

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Project Manager:

*Cal Woolsey, PE*

Fuscoe Job Number:

*1413.001.01*

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*June 10, 2016*

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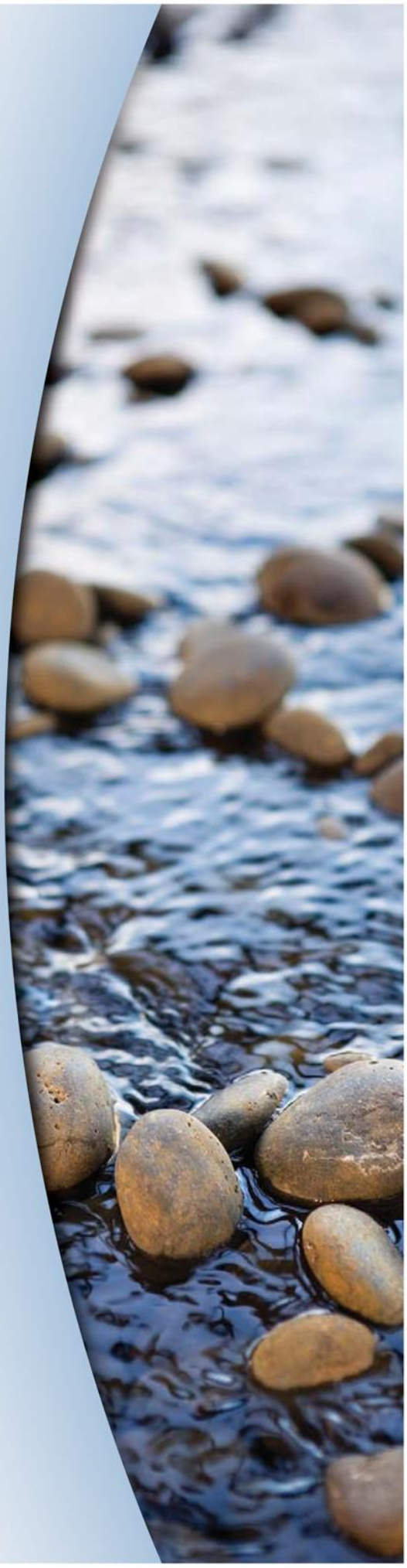

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# Del Amo Financial Center Sewer Impact Study

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## Project Details

Project: Del Amo Financial Center – Torrance, CA
Client: Muller Company
Fuscoe Engineering, Inc. Project No: 1413.001
Authority Having Jurisdiction: City of Torrance & County Sanitation Districts of Los Angeles County

## Vicinity Map

## Project Introduction

The Del Amo Financial Center is located in the City of Torrance, California and is comprised of a 12-story office tower, 5-story office tower, and four 2-story circular office buildings. The site is bounded by Hawthorne Boulevard to the east, Carson Street to the south, and Del Amo Circle to the west and north. The limits of this sewer study are for existing and proposed buildings in the northeastern portion of the project site.

The proposed project consists of adding a 47,000 square foot fitness facility and 12,000 square foot restaurant. An existing circular office building, currently being utilized as a restaurant, will be demolished.

The entire site is served by a City of Torrance sewer (12" VCP) within Hawthorne Boulevard. This sewer ultimately discharges into the County Sanitation Districts of Los Angeles County (LACSD) South Torrance trunk main (15" VCP) at the intersection of Hawthorne Boulevard and Sepulveda Boulevard.

The baseline for this sewer study was acquired from an approved sewer study (reports listed below) conducted for the Del Amo Fashion Center located directly adjacent to the Financial Center (see vicinity map on page 2).

- Del Amo Fashion Center Original Sewer Study – Dated 3/17/14, Approved 3/25/14
- Addendum No. 1 – Dated 9/10/14, Approved 9/25/14
- Addendum No. 2 – Dated 9/9/15, Approved 9/15/15

A portion of the Fashion Center discharges to the Hawthorne Boulevard in a manner similar to the Financial Center project site. Flow monitoring data collected during the Fashion Center sewer study was the original baseline used for its respective sewer study and is included with this report (see Appendix A & D). The flow monitoring station, designated as HAWT01, was located just south of the Hawthorne Boulevard and Carson Street intersection measuring southward flow (see vicinity map on page 2). The flow monitoring station, designated as HAWT03, was located further south along Hawthorne, closer to the intersection with Sepulveda. The temporary flow monitoring, conducted by ADS Environmental Services, collected 14 continuous days of data at 5-minute intervals.

The purpose of this study is to investigate the effects of this proposed project on the Hawthorne Boulevard sewer.

## Methodology

The methodology for determining a sewer's capacity is as follows:

### Existing Conditions (Baseline)

1. Observe sewer flow conditions and measure maximum flow rate (MGD or CFS).
2. Calculate maximum depth from measured maximum flow using Manning's equation.
3. Divide the calculated maximum depth by the diameter of sewer pipe to determine the percent full.
4. Cross check measured flows with flows determined in City of Torrance's Sewer Master Plan dated 1992.

### Proposed Conditions (Proposed Improvements)

1. Calculate total additional daily flow to be produced by proposed improvements using average daily flow of buildings defined by "Ordinance Prescribing The Connection Fee Rate And Mean Loadings Per Unit Of Usage For County Sanitation District No. 5 Of Los Angeles County". (see Appendix C)
2. Apply peaking factor to proposed additional daily flow.
3. Add proposed peak flow to baseline existing flow.
4. Calculate maximum depth from total proposed peak flow using Manning's equation.
5. Divide the calculated maximum depth by the diameter of sewer pipe to determine the percent full.

### Assumptions

- A Manning's roughness coefficient of n=0.013 for vitrified clay pipe (VCP) was used in Manning's equation. This same roughness coefficient was utilized in the previously approved Del Amo Fashion Center sewer study.

- The sanitary sewer lines under consideration are less than or equal to 12" in size and therefore are typically designed to run at a maximum of 50% capacity. Sanitary sewer lines larger than 12" are typically considered trunk mains and are designed to operate at a maximum of 75% capacity.

### Software

Bentley FlowMaster V8i (SELECTseries 1) was utilized for Manning's formula calculations. Software reports are included in the appendices.

## Existing Condition

### Existing Condition of Hawthorne Blvd Sewer Prior to Mall Improvements

The existing condition of the Hawthorne Blvd sewer prior to the recent Del Amo Fashion Center improvements was determined from flow monitoring data from the sewer study performed by Tait & Associates, revised March 17, 2014. The sewer was observed as running at 43.48% full at peak flow.

| Flow Monitor Station | Location | Pipe Diameter (inches) | Slope (%) | Measured Max Flow (mgd) | Measured Max Flow (cfs) | Measured Max Depth (inches) | Calculated Max Depth at Max Flow (inches) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|---|
| HAWT01 | Hawthorne and Carson | 12 | 0.24 | 0.442 | 0.6839 | 5.04 | 5.22 | 2.09 | 43.48 |
| HAWT03 | Hawthorne and Sepulveda | 12 | 0.24 | 0.424 | 0.6561 | 4.90 | 5.10 | 2.06 | 42.48 |
| HAWT01 (1992 MP*) | Hawthorne and Carson | 12 | 0.218 | 0.237 | 0.3672 | 3.8 | 3.72 | 1.701 | 22 |
| HAWT03 (1992 MP*) | Hawthorne and Sepulveda | 12 | 0.239 | 0.305 | 0.4721 | 4.3 | 4.32 | 1.885 | 27 |

*Existing condition based on Del Amo Fashion Center Original Sewer Study – Dated 3/17/14, Approved 3/25/14*
** Measured flows from City of Torrance's Sewer Master Plan dated 1992 for comparison*

### Existing Condition of Hawthorne Blvd Sewer Following Mall Improvements (Original Study)

The improvements to the mall included:

- Demolition of approximately 58,000 SF of existing medical office building at the southeast corner of Fashion Way and Hawthorne Boulevard
- Demolition of approximately188,000 SF of the existing mall
- Construction of approximately 558,000 SF of mall expansion

The condition of the Hawthorne Blvd sewer following the first phase of mall improvements was theoretically determined to be 46.25% full.

| Flow Monitor Station | Location | Pipe Diameter (inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (Base Peak Plus Add'l Peak) (cfs) | Calculated Max Depth at Prop. Peak Flow (inches) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|
| HAWT01 | Hawthorne and Carson | 12 | 0.24 | 0.6839 | 0.7629 | 5.55 | 2.15 | 46.25 |
| HAWT03 | Hawthorne and Sepulveda | 12 | 0.24 | 0.6561 | 0.7351 | 5.43 | 2.13 | 45.28 |

*Existing condition based on Del Amo Fashion Center Original Sewer Study – Dated 3/17/14, Approved 3/25/14*

### Existing Condition of Hawthorne Blvd Sewer Following Additional Mall Improvements (Addendum #1)

The Del Amo Fashion Center sewer study was revised in September 2014 to account for additional improvements. These additional improvements included two proposed restaurant pads to be constructed on the west side of the mall expansion. The condition of the Hawthorne Blvd sewer following these improvements was theoretically determined to be 48.92% full.

| Flow Monitor Station | Location | Pipe Diameter (inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (Base Peak Plus Add'l Peak) (cfs) | Calculated Max Depth at Prop. Peak Flow (inches) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|
| HAWT01 | Hawthorne and Carson | 12 | 0.24 | 0.6839 | 0.8409 | 5.87 | 2.20 | 48.92 |
| HAWT03 | Hawthorne and Sepulveda | 12 | 0.24 | 0.6561 | 0.8131 | 5.76 | 2.18 | 47.97 |

*Existing condition based on Del Amo Fashion Center Sewer Study Addendum No. 1 Dated 9/10/14, Approved 9/25/14*

### Existing Condition of Hawthorne Sewer Following Additional Mall Improvements (Addendum #2)

The Fashion Center sewer study was again revised in September 2015 to divert sewer flow from a mall restaurant pad and the Nordstrom building to the sewer within Fashion Way instead of Hawthorne Boulevard to allow for additional future restaurants. Per the City's request, Addendum #2 will be ignored for the purposes of this report. The baseline assumed for this report will be the results set forth above by Addendum #1.

## Proposed Condition

The proposed improvements for the Del Amo Financial Center include the construction of a 47,227 SF fitness center and a 12,031 SF restaurant pad. Three different scenarios are portrayed below to give alternatives to mitigate impacts to the Hawthorne Boulevard sewer, which is running near full capacity. Full capacity for a 12" diameter city sewer main is defined as being 50% full.

- Scenario 1: All improvements are typical and no sewage is detained on site.
- Scenario 2: Half of the sewer flow from the 12-story office tower is temporarily detained on-site and discharged at off peak hours.
- Scenario 3: All of the sewer flow from the 12-story office tower is temporarily detained on-site and discharged at off peak hours.

### Scenario 1: No Delayed Discharge of 12-Story Office Tower

| Building | Use/Type | Unit | Average Daily Flow (gpd/unit) [1] | Total Daily Flow (gpd) |
|---|---|---|---|---|
| Exist. Restaurant | Restaurant | -8,244 SF | 1000/1000 gross SF | -8,244 |
| Prop. Restaurant | Restaurant | 12,031 SF | 1000/1000 gross SF | 12,031 |
| Prop. Fitness Center | Health Spa, Gymnasium (with showers) | 47,227 SF | 600/1000 gross SF | 28,336 |
| | | | Net Total | 32,123 |

Convert "Total Daily Flow (gpd)" into "Average Flow (cfs)": $32{,}123\ gpd \times \frac{1\ ft^3}{7.4805\ gal} \times \frac{1\ day}{86{,}400\ sec} = 0.04970\ cfs$

Calculate Peak Flow (cfs): $(0.04970\ \text{cfs}^{0.906}) \times 2.65 = 0.1746\ cfs$

| Flow Monitor Station | Location | Pipe Diameter (inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (cfs) | Calculated Max Depth at Prop. Peak Flow (inches) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|
| HAWT01 | Hawthorne and Carson | 12 | 0.24 | 0.8409 | 1.0155 | 6.60 | 2.31 | 54.8 |

### Scenario 2: Delayed Discharge of Half of 12-Story Office Tower

Subtraction of half of 12-story office tower sewer flow (delayed sewer discharge to off-peak hours)

| Building | Use/Type | Unit | Average Daily Flow (gpd/unit) [1] | Total Daily Flow (gpd) |
|---|---|---|---|---|
| 12-Story Office | Commercial Office Space | -100,000 SF | 200/1000 gross SF | -20,000 |
| Exist. Restaurant | Restaurant | -8,244 SF | 1000/1000 gross SF | -8,244 |
| Prop. Restaurant | Restaurant | 12,031 SF | 1000/1000 gross SF | 12,031 |
| Prop. Fitness Center | Health Spa, Gymnasium (with showers) | 47,227 SF | 600/1000 gross SF | 28,336 |
| | | | Net Total | 12,123 |

Convert "Total Daily Flow (gpd)" into "Average Flow (cfs)": $12{,}123\ gpd \times \frac{1\ ft^3}{7.4805\ gal} \times \frac{1\ day}{86{,}400\ sec} = 0.01876\ cfs$

Calculate Peak Flow (cfs): $(0.01876\ \text{cfs}^{0.906}) \times 2.65 = 0.0722\ cfs$

| Flow Monitor Station | Location | Pipe Diameter (inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (cfs) | Calculated Max Depth at Prop. Peak Flow (inches) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|
| HAWT01 | Hawthorne and Carson | 12 | 0.24 | 0.8409 | 0.9131 | 6.12 | 2.25 | 51.3 |

### Scenario 3: Delayed Discharge of All of 12-Story Office Tower

Subtraction of all of 12-story office tower sewer flow (delayed sewer discharge to off-peak hours)

| Building | Use/Type | Unit | Average Daily Flow (gpd/unit) [1] | Total Daily Flow (gpd) |
|---|---|---|---|---|
| 12-Story Office | Commercial Office Space | -200,000 SF | 200/1000 gross SF | -40,000 |
| Exist. Restaurant | Restaurant | -8,244 SF | 1000/1000 gross SF | -8,244 |
| Prop. Restaurant | Restaurant | 12,031 SF | 1000/1000 gross SF | 12,031 |
| Prop. Fitness Center | Health Spa, Gymnasium (with showers) | 47,227 SF | 600/1000 gross SF | 28,336 |
| | | | Net Total | -7,877 |

Convert "Total Daily Flow (gpd)" into "Average Flow (cfs)": $-7{,}877\ gpd \times \frac{1\ ft^3}{7.4805\ gal} \times \frac{1\ day}{86{,}400\ sec} = -0.01219\ cfs$

Calculate Peak Flow (cfs): $-(0.01219\ \text{cfs}^{0.906}) \times 2.65 = -0.0489\ cfs$

| Flow Monitor Station | Location | Pipe Diameter (inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (cfs) | Calculated Max Depth at Prop. Peak Flow (inches) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|
| HAWT01 | Hawthorne and Carson | 12 | 0.24 | 0.8409 | 0.7920 | 5.64 | 2.17 | 47.2 |

[1] Average daily flow defined by "Ordinance Prescribing The Connection Fee Rate And Mean Loadings Per Unit Of Usage For County Sanitation District No. 5 Of Los Angeles County.

## Conclusion

The Hawthorne Boulevard sewer is currently operating at a peak of 48.9% full following recent mall improvements. It is designed to operate at a maximum of 50% capacity. The proposed improvements of this project include the addition of a fitness center and a new restaurant, while concurrently demolishing an existing restaurant. If these proposed improvements are allowed to directly discharge into the Hawthorne Boulevard sewer, the calculated peak flows will push the overall capacity to 54.8%, well over the maximum of 50% full.

This study provides alternative scenarios to mitigate the results of these proposed improvements. The scenarios analyze the effects of storing sewage on site in a tank and delaying the discharge until known off-peak hours. Site constraints of this project result in the 12-story office tower to be the optimal candidate for on-site sewer storage and delayed discharge. The alternative scenarios investigate storing either half of the total daily flow or all of the total daily flow of the 12-story building. Storing half of the total daily flow results in the Hawthorne sewer operating at a peak of 51.3% full, still exceeding the allowed limit. Storing the entire total daily flow, however, improves the condition. This would ultimately result in the Hawthorne sewer operating at a peak of 47.2% full, well within allowable limits.

The tank would be sized to store one entire day's flow and discharge only at off peak hours, which are predominantly in the evenings and middle of the night. Pump data including flow rates and pumping schedules could be digitally transmitted or provided as a report at predetermined intervals to City staff. The tank would be located directly adjacent to the building and would be underground. Please see the concept plan on page 12.

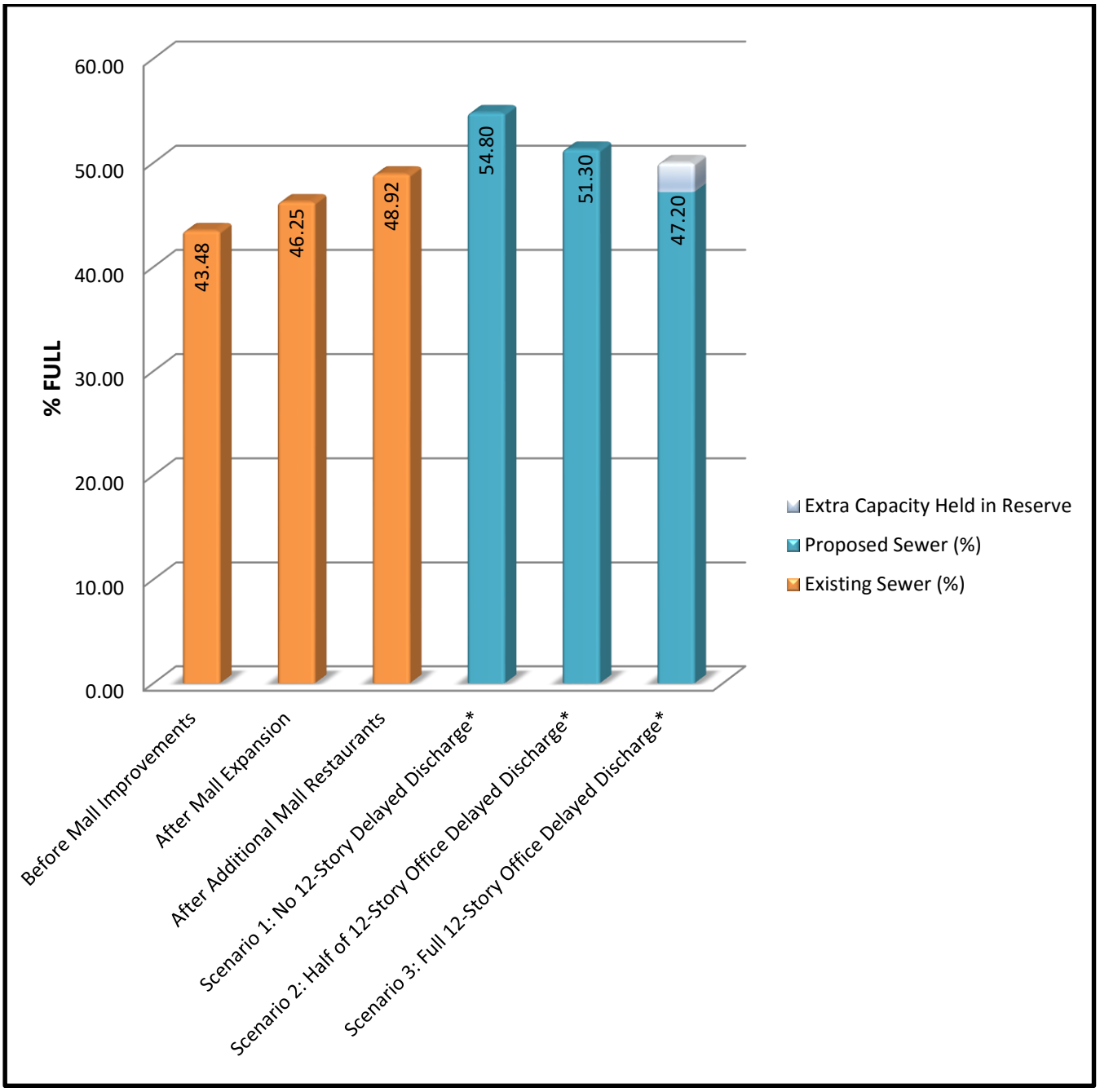
Mitigating the Hawthorne Boulevard sewer capacity is of benefit to the City and will allow for future development in this area without the need to immediately upsize the line. We respectfully are requesting review of these alternatives in order to proceed with on-site utility engineering design.

| | |
|---|---|
| Existing Condition (Following Mall Improvements) | *48.9% Full* |
| Scenario 1: No Delayed Discharge of 12-Story Office Tower* | *54.8% Full* |
| Scenario 2: Delayed Discharge of Half of 12-Story Office Tower* | *51.3% Full* |
| Scenario 3: Delayed Discharge of All of 12-Story Office Tower* | *47.2% Full* |

*Fitness center and proposed restaurant included in Scenarios 1,2,3

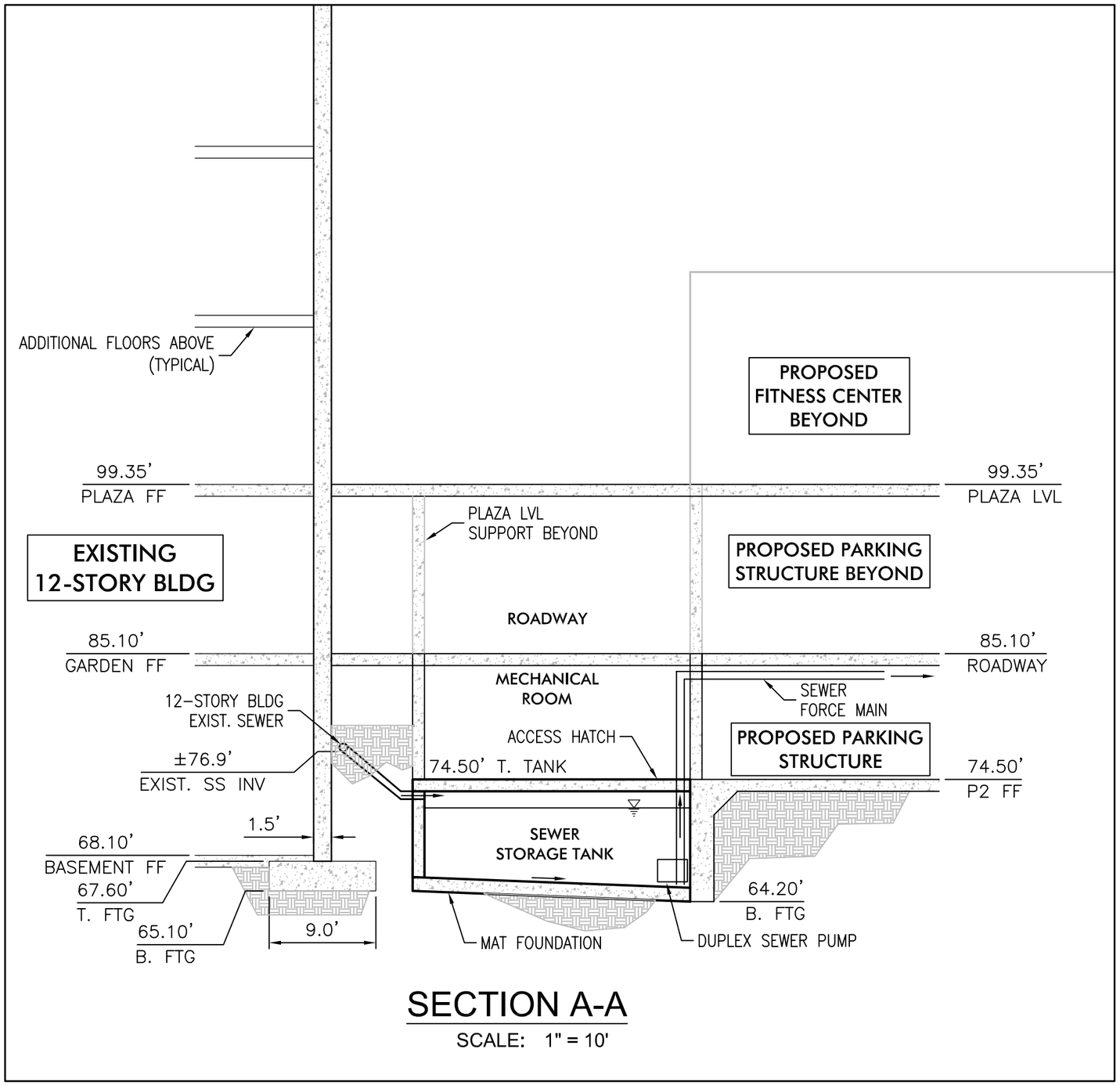
Fuscoe Engineering respectfully requests approval of Scenario 3 indicated above.

## Sewer Capacity Summary Diagram



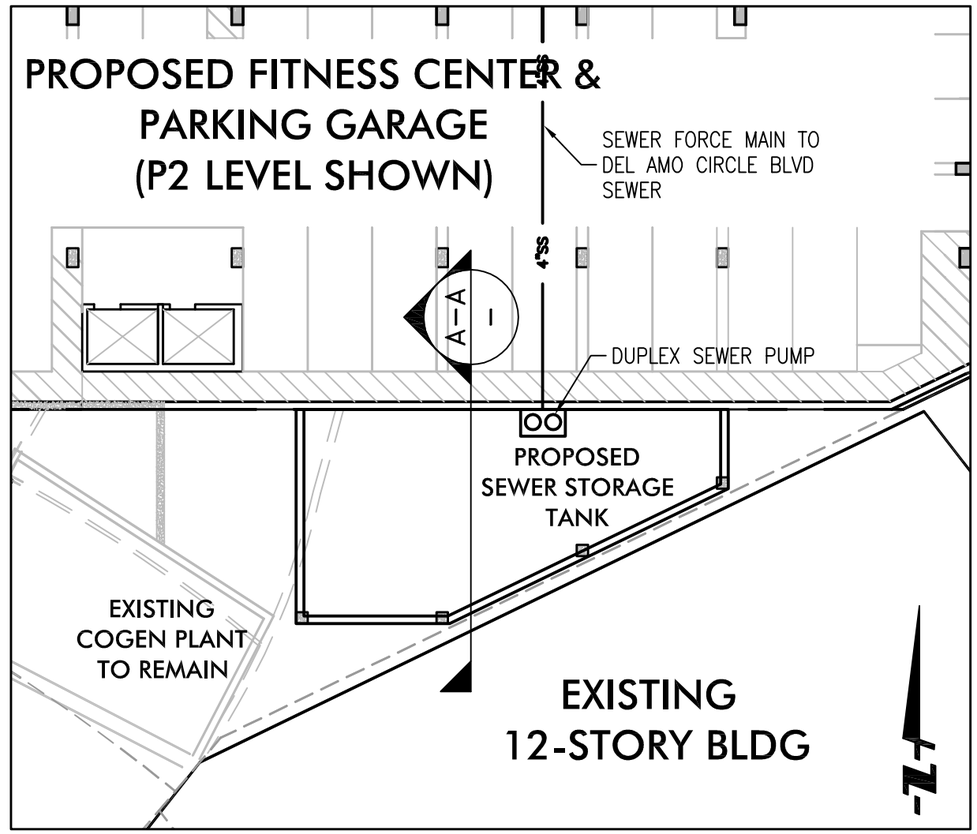

*Fitness center and proposed restaurant included in Scenarios 1,2,3

## Sewer Storage Tank Conceptual Plan




## SECTION A-A

SCALE: 1" = 10'




20' 0' 10' 20'

SCALE: 1" = 20'

# DEL AMO FINANCIAL PLAZA - SEWER TANK CONCEPTUAL PLAN

21515-21615 HAWTHORNE BOULEVARD
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## Appendix Summary

A. *Existing Conditions Sewer Study Results by ADS Environmental Services – Performed May 2013*
B. *Sewer Master Plan of City of Torrance Hawthorne Boulevard Sewer*
    a. *Sewer Master Plan – Dated 1992*
    b. *Flowmaster Manning's Equation Results for HAWT01 & HAWT03*
    c. *Flowmaster Cross Section for HAWT01 & HAWT03*
C. Ordinance Prescribing The Connection Fee Rate And Mean Loadings Per Unit Of Usage For County Sanitation District No. 5 Of Los Angeles County
D. *Existing Conditions Following Mall Improvements (Baseline)*
    a. *Portions of Del Amo Fashion Center Original Sewer Study by Tait & Associates, Inc. Dated 3/17/14, Approved 3/25/14*
E. *(Scenario 1) Proposed Conditions of Hawthorne Boulevard Sewer*
    a. *Flowmaster Manning's Equation Results*
    b. *Flowmaster Cross Section*
    c. *Sewer Capacity Calculations Spreadsheet*
F. *(Scenario 2) Proposed Conditions of Hawthorne Boulevard Sewer*
    a. *Flowmaster Manning's Equation Results*
    b. *Flowmaster Cross Section*
    c. *Sewer Capacity Calculations Spreadsheet*
G. *(Scenario 3) Proposed Conditions of Hawthorne Boulevard Sewer*
    a. *Flowmaster Manning's Equation Results*
    b. *Flowmaster Cross Section*
    c. *Sewer Capacity Calculations Spreadsheet*


# Hawthorne Blvd. Sewer Flow Study

# Torrance, CA

**May 18, 2013 - May 31, 2013**

Prepared for:

**Michael Silvey, PE**
**Vice President**
**Tait & Associates, Inc.**
**701 N. Parkcenter Drive**
**Santa Ana, CA 92705**

Prepared by:

ADS, LLC
**15205 Springdale Street**
**Huntington Beach, CA 92649**

## Letter of Transmittal

*A Division of ADS LLC*

15205 Springdale Street
Huntington Beach, CA 92649-1156

www.adsenv.com

June 17, 2013

Michael Silvey, PE
Tait & Associates, Inc.
701 N. Parkcenter Drive
Santa Ana, CA 92705

Dear Mr. Silvey,

ADS is pleased to submit the Hawthorne Blvd. Sewer Flow Study conducted in the City of Torrance, CA on behalf of Tait & Associates, Inc. Metering was performed at three (3) locations for the period of May 18, 2013 through May 31, 2013 . Included in the report are depth, velocity and quantity hourly averaged hydrographs as well as daily long tables for the metering period in PDF format. An excel file containing Depth, Quantity, and Velocity entities for the flow monitoring location in 5-minute format is also provided.

In addition, we would be happy to further explain any details about the report that may seem unclear. Should you have any questions or comments, I can be reached at (256) 759-2575. You may also contact the Project Manager, Paul Mitchell at (714) 379-9778 ext 223.

Thank you for choosing ADS products and services to meet your flow monitoring needs.

Sincerely,
ADS ENVIRONMENTAL SERVICES

KaTonya Sledge

Sr. Data Analyst

## Methodology

### Introduction

### Background

Tait & Associates, Inc. entered into agreement with ADS Environmental Services to conduct flow monitoring at (3) three locations in the City of Torrance, CA. The study was scheduled for a 14-day period. The objective of this study was to confirm flow to aid in determining furture development capacity.

### Project Scope

The scope of this study involved using temporary flow monitors to quantify wastewater flows at the designated locations. Specifically, the study included the following key components.

- Investigate the proposed flow-monitoring sites for adequate hydraulic conditions.
- Flow monitor installations.
- Flow monitor confirmations and data collections.
- Flow data analysis.

Equipment installation was completed by May 17, 2013. The 14-day study period began on Saturday, May 18, 2013 and concluded on Friday, May 31, 2013 .

### Equipment and Methodology

### Flow Quantification Methods

There are two main equations used to measure open channel flow: the Continuity Equation and the Manning Equation. The Continuity Equation, which is considered the most accurate, can be used if both depth of flow and velocity are available. In cases where velocity measurements are not available or not practical to obtain, the Manning Equation can be used to estimate velocity from the depth data based on certain physical characteristics of the pipe (i.e. the slope and roughness of the pipe being measured). However, the Manning equation assumes uniform, steady flow hydraulic conditions with non-varying roughness, which are typically invalid assumptions in most sanitary sewers. The Continuity Equation was used exclusively for this study.

Continuity Equation

The Continuity Equation states that the flow quantity (Q) is equal to the wetted area (A) multiplied by the average velocity (V) of the flow.

$$Q = A * V$$

This equation is applicable in a variety of conditions including backwater, surcharge, and reverse flow. Most modern flow monitoring equipment, including the ADS Models, measure both depth and velocity and therefore use the Continuity Equation to calculate

flow quantities.

**Flow Monitoring Equipment**

The monitor selected for this project was the ADS Model 3600-flow monitor. This flow monitor is an area flow monitor that uses both the Continuity and Manning's equations to measure flow.

The ADS Model 3600-flow monitor consists of data acquisition sensors and a battery-powered microcomputer. The microcomputer includes a processor unit, data storage, and an on-board clock to control and synchronize the sensor recordings. The monitor was programmed to acquire and store depth of flow and velocity readings at 5-minute intervals.

Three types of data acquisition sensors are available for the Model 3600-flow monitor. The primary depth measurement device is the ADS quad-redundant ultrasonic level sensor. This sensor uses four independent ultrasonic transceivers in pairs to measure the distance from the face of the transceiver housing to the water surface (air range) with up to four transceiver pairs, of the available ones, active at one time. The elapsed time between transmitting and receiving the ultrasonic waves is used to calculate the air range between the sensor and flow surface based on the speed of sound in air. Sensors in the transceiver housing measure temperature, which is used to compensate the ultrasonic signal travel time. The speed of sound will vary with temperature. Since the ultrasonic level sensor is mounted out of the flow, it creates no disturbance to normal flow patterns and does not affect site hydraulics.

Redundant flow depth data can be provided by a pressure depth sensor, and is independent from the ultrasonic level sensor. This sensor uses a piezo-resistive crystal to determine the difference between hydrostatic and atmospheric pressure. The pressure sensor is temperature compensated and vented to the atmosphere through a desiccant filled breather tube. Pressure depth sensors are typically used in large size channels and applications where surcharging is anticipated. Its streamlined shape minimizes flow distortion.

Velocity is measured using the ADS V-3 digital Doppler velocity sensor. This sensor measures velocity in the cross-sectional area of flow. An ultrasonic carrier is transmitted upstream into the flow, and is reflected by suspended particles, air bubbles, or organic matter with a frequency shift proportional to the velocity of the reflecting objects. The reflected signal is received by the sensor and processed using digital spectrum analysis to determine the peak flow velocity. Collected peak velocity information is filtered and processed using field confirmation information and proprietary software to determine the average velocity, which is used to calculate flow quantities. The sensor's small profile, measuring 1.5 inches by 1.15 inches by 0.50 inches thick, minimizes the affects on flow patterns and site hydraulics.

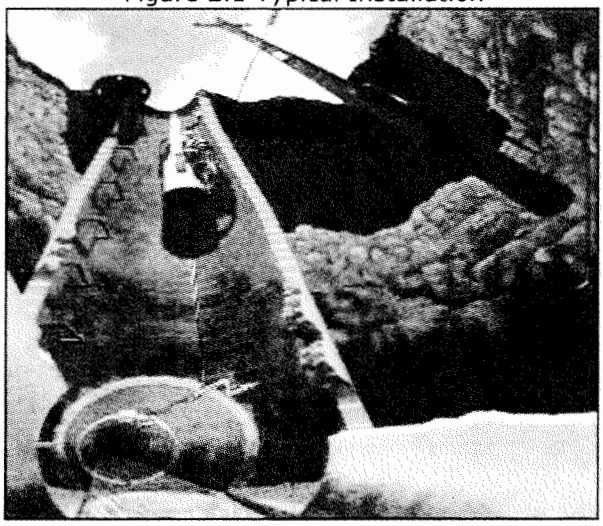
**Installation**

Installation of flow monitoring equipment typically proceeds in four steps. First, the site is investigated for safety and to determine physical and hydraulic suitability for the flow monitoring equipment. Second, the equipment is physically installed at the selected location. Third, the monitor is tested to assure proper operation of the velocity and depth of flow sensors and verify that the monitor clock is operational and synchronized to the

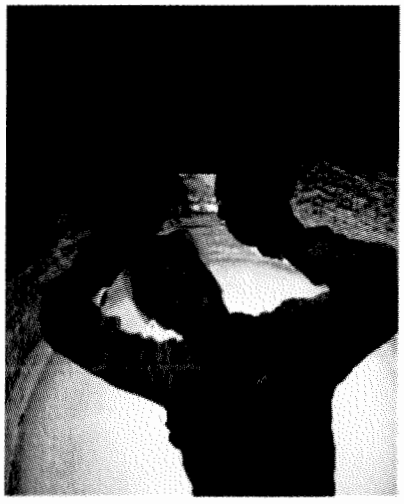
master computer clock. Fourth, the depth and velocity sensors are confirmed and line confirmations are performed. A typical flow monitor installation is shown in Figure 2.1.

The installations depicted in Figures 2.1 are typical for circular or oval pipes up to approximately 104-inches in diameter or height. In installations into pipes 42-inches or less in diameter, depth and velocity sensors are mounted on an expandable stainless steel ring and installed one to two pipe diameters upstream of the pipe/manhole connection in the incoming sewer pipe. This reduces the affects of turbulence and backwater caused by the connection. In pipes larger than 42 inches in diameter, a special installation is made using two sections of the ring installed one to two feet upstream of the pipe/manhole connection; one bolted to the crown of the pipe for the depth sensor, and the other bolted to the bottom of the pipe (bolts are usually placed just above the water line) to hold the velocity sensor.

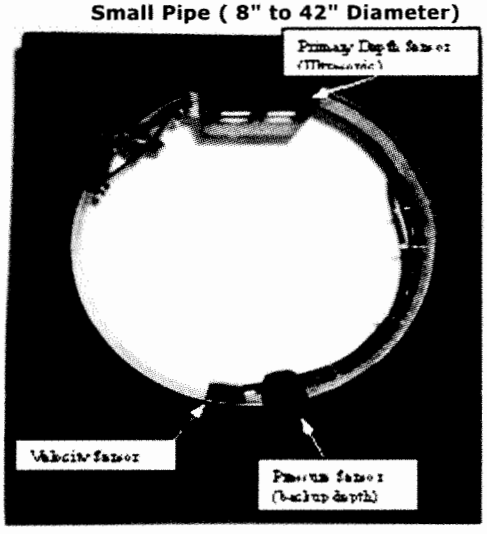
Figure 2.1 Typical Installation



**Large Pipe ( > 42" Diameter)**



**Small Pipe ( 8" to 42" Diameter)**



### Data Collection, Confirmation, and Quality Assurance

During the monitoring period, field crews visit each monitoring location to retrieve data, verify proper monitor operation, and document field conditions. The following quality assurance steps are taken to assure the integrity of the data collected:

- **Measure Power Supply:** The monitor is powered by a dry cell battery pack. Power levels are recorded and battery packs replaced, if necessary. A separate battery provides back-up power to memory, which allows the primary battery to be replaced without the loss of data.

- **Perform Pipe Line Confirmations and Confirm Depth and Velocity:** Once equipment and sensor installation is accomplished, a member of the field crew descends into the manhole to perform a field measurement of flow rate, depth and velocity to confirm they are in agreement with the monitor. Since the ADS V-3 velocity sensor measures peak velocity in the wetted cross-sectional area of flow, velocity profiles are also taken to develop a relationship between peak and average velocity in lines that meet the hydraulic criteria.

- **Measure Silt Level:** During site confirmation, a member of the field crew descends into the manhole and measures and records the depth of silt at the bottom of the pipe. This data is used to compute the true area of flow.

- **Confirm Monitor Synchronization:** The field crew checks the flow monitor's clock for accuracy.

- **Upload and Review Data:** Data collected by the monitor is uploaded and reviewed for comparison with previous data. All readings are checked for consistency and screened for deviations in the flow patterns, which indicate system anomalies or equipment failure.

### Data Analysis and Presentation

### Data Analysis

A flow monitor is typically programmed to collect data at either 15-minute or 5-minute intervals throughout the monitoring period. The monitor stores raw data consisting of (1) the air range (distance from sensor to top of flow) for each active ultrasonic depth sensor pair and (2) the peak velocity. If the monitor is equipped with a pressure sensor, then a depth reading from this sensor may also be stored. When the field personnel collects the data, the air range is converted to depth data based on the pipe height and physical offset (distance from the top of the pipe to the surface of the ultrasonic sensor). The data is imported into ADS's proprietary software and is examined by a data analyst to verify its integrity. The data analyst also reviews the daily field reports and site visit records to identify conditions that would affect the collected data.

Velocity profiles and the line confirmation data developed by the field personnel are reviewed by the data analyst to identify inconsistencies and verify data integrity. Velocity profiles are reviewed and an average to peak velocity ratio is calculated for the site. This ratio is used in converting the peak velocity measured by the sensor to the average velocity used in the Continuity equation. The data analyst selects which ultrasonic pairs and/or depth sensor entity will be used to calculate the final depth information. Silt levels present at each site visit are reviewed and representative silt levels established.

Selections for the above parameters can be constant or can change during the monitoring period. While the data analysis process is described in a linear manner, it

often requires an iterative approach to accurately complete.

**Data Presentation**

This type of flow monitoring project generates a large volume of data. To facilitate review of the data, results have been provided in graphical and tabular formats. The flow data is presented graphically in the form of scattergraphs and hydrographs. The data depicted on the hydrograph is based on hourly averaged data. Tables are provided in daily average format. These tables show the flow rate for each day, along with the daily minimum and maximums, the times they were observed, the total daily flow, and total flow for the month (or monitoring period). The summary tables in the report show minimum and maximum data based on 5-minute data intervals recorded. The following explanation of terms may aid in interpretation of the tables and hydrographs. These entities are based on 5-minute interval data.

**DEPTH** - Final calculated depth measurement (in inches)

**QUANTITY** - Final calculated flow rate (in MGD)

**VELOCITY** - Final calculated flow velocity (in feet per second)

**REPORT TOTAL** - Total volume of flow recorded for the indicated time period (in MGD).

**MINIMUM DEPTH -** Lowest depth of flow recorded during the study period (in inches).

**MAXIMUM DEPTH -** Highest depth of flow recorded during the study period (in inches).

**MINIMUM VELOCITY -** Lowest flow velocity recorded during the study period (in feet per second).

**MAXIMUM VELOCITY** - Highest flow velocity reported during the study period (in feet per second).

**MINIMUM QUANTITY** - Lowest quantity of flow reported during the study period (in MGD).

**MAXIMUM QUANTITY -** Highest quantity of flow recorded during the study period (in MGD)

## Site Commentary

### Site Information

| CARS04 | |
|---|---|
| Pipe Dimensions | 10 " |
| Silt Level | 0.00" |

### Overview

Site CARS04 functioned under normal conditions during the period Saturday, May 18, 2013 to Friday, May 31, 2013 . No surcharge conditions were experienced at this location. Review of the scattergraph shows that flow in this line remained free-flowing throughout the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

### Observations

Average flow depth, velocity, and quantity data observed during Saturday, May 18, 2013 to Friday, May 31, 2013 , along with observed minimum and maximum data, are provided in the following table. In regards to depth, this site flows at 32.7% full at its recorded hourly peak at 3.27 inches and approximately 24.3% full during the typical hourly average depth of 2.43 inches.

| Observed Flow Conditions | | | |
|---|---|---|---|
| Item | Depth (in) | Velocity (ft/s) | Quantity (MGD) |
| Average | 2.43 | 1.18 | 0.083 |
| Minimum | 1.25 | 0.48 | 0.012 |
| Maximum | 3.62 | 1.74 | 0.196 |
| Time of Minimum | 5/21/2013 2:25 AM | 5/21/2013 2:25 AM | 5/21/2013 2:25 AM |
| Time of Maximum | 5/28/2013 2:15 PM | 5/24/2013 9:50 PM | 5/28/2013 2:15 PM |

### Data Quality

Data uptime observed during the Saturday, May 18, 2013 to the Friday, May 31, 2013 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

| Percent Uptime | |
|---|---|
| Depth (in) | 100 |
| Velocity (ft/s) | 100 |
| Quantity (MGD) | 100 |

ADS ENVIRONMENTAL SERVICES®

# ADS Site Report

**Quality Form**

| | | | |
|---|---|---|---|
| **Project Name:** Torancee Tait 2013 | **City:** Torrance, CA | **Agency:** Torrance | **FM Initials:** SK |
| **Site Name:** CARS04 | **Install Date:** 5/17/13 | **Monitor Type** | Peak Doppler |
| | | **Monitor Model** | 3600 |
| **ess/Location:** | Hawthorne Blvd and W Carson St. | **Data Acquisition** | Manual Collect |
| | | **Manhole ID** | N/A |
| **Access:** Drive | **Type of System:** Sanitary [X] Storm [ ] Combined [ ] | **Pipe Height:** | 10.00 " |
| | | **Pipe Width:** | 10.00 " |



## Investigation Information:

| | |
|---|---|
| **Date/Time of Investigation:** | 5/17/13 |
| **Site Hydraulics:** | Good straight through flow |
| **Upstream Input: (L/S, P/S)** | DNI |
| **eam Manhole:** | DNI |
| **tream Manhole:** | DNI |
| **Depth of Flow:** | 2.63 " +/- 0.13" |
| **Range (Air DOF):** | +/- |
| **Peak Velocity:** | 1.43 fps |
| **Silt:** | 0.00 Inches |

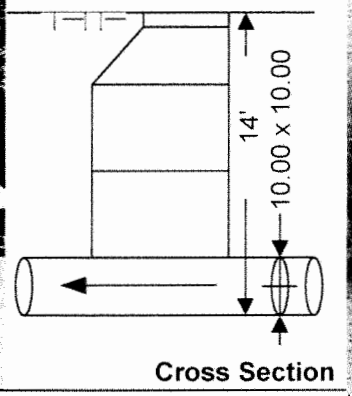
## Manhole Information:

| | | | | |
|---|---|---|---|---|
| **Manhole Depth:** | 14' | | | |
| **Manhole Material / Condition** | Brick/OK | | | |
| **Pipe Material / Condition:** | VCP/Good | | | |
| **Land Use:** | Residential [X] | Commercial [ ] | Industrial [ ] | Trunk [ ] |
| **Oxygen:** 20.9 | **H2S:** 0 | **LEL:** 0 | **CO:** 0 | |

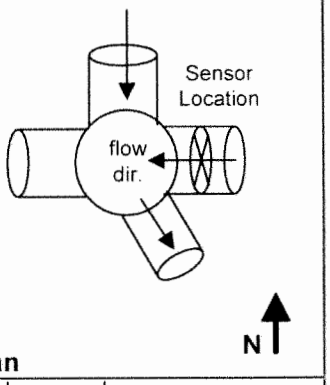
**Safety Notes:**

2 man crew required.

## Other Information:




Cross Section




Plan

| Installation Information | | Backup | Yes | No | ? | Distance |
|---|---|---|---|---|---|---|
| Installation Type: | Ring | Trunk | [ ] | [x] | [ ] | |
| Sensors Devices: | Ultrasonic / Pressure/ Velocity | Lift / Pump Station | [ ] | [x] | [ ] | |
| Surcharge Height: | 0 | WWTP | [ ] | [x] | [ ] | |
| Gauge Zone: | | Other | [ ] | [X] | [ ] | |

## Additional Site Information / Comments:

**Standard Traffic Control with No Safety Concerns**

# SCATTERGRAPH REPORT

CARS04

**Flow Monitor**

**CARS04**

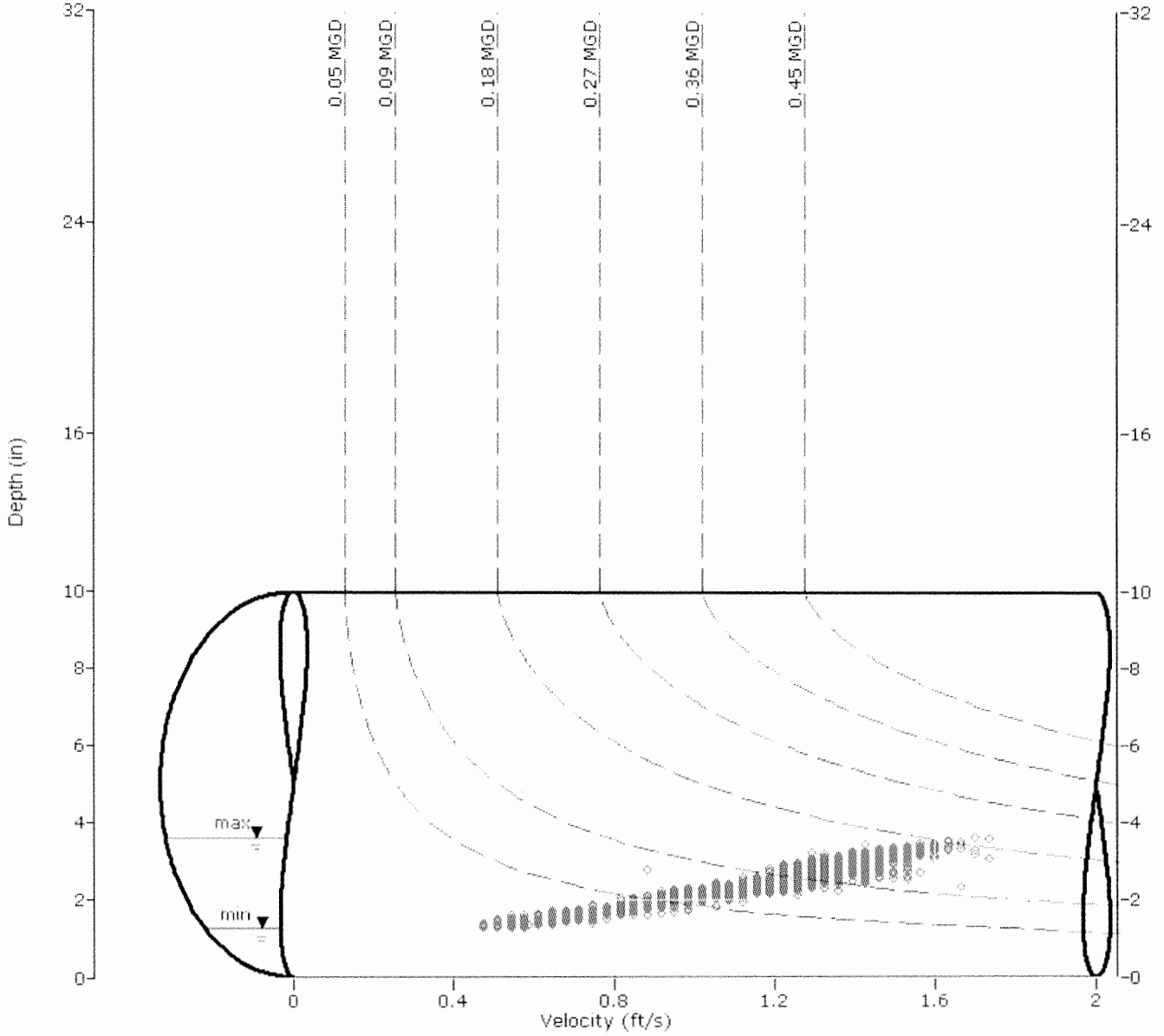
Pipe Height
10.00 in

**Report Period**

5/18/2013
To
5/31/2013

**Legend**

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth




ADS ENVIRONMENTAL SERVICES

# HYDROGRAPH REPORT

CARS04

**Flow Monitor**

**CARS04**

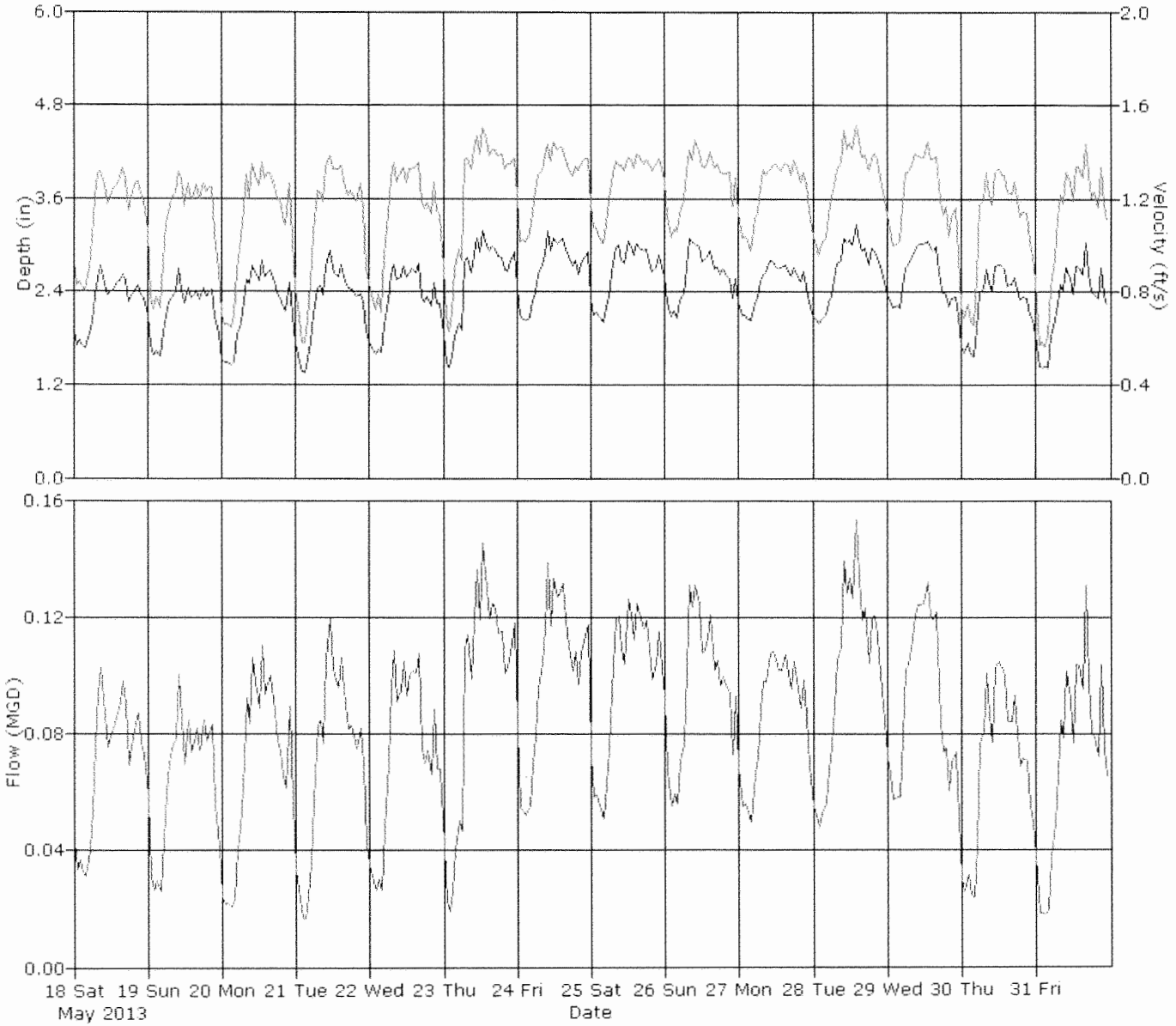
Pipe Height
10.00 in

**Report Period**

5/18/2013
To
5/31/2013

**Legend**

- Depth
- Velocity
- Quantity




ADS ENVIRONMENTAL SERVICES

## Daily Tabular Report

| Date | Depth (in) | | | | | Velocity (ft/s) | | | | | Quantity (MGD - Total MG) | | | | | | Rain (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Total | Total |
| 5/18/2013 | 01:35 | 1.48 | 09:05 | 3.13 | 2.26 | 02:45 | 0.61 | 08:30 | 1.53 | 1.14 | 02:45 | 0.021 | 09:05 | 0.144 | 0.071 | 0.071 | |
| 5/19/2013 | 04:30 | 1.44 | 13:20 | 2.89 | 2.18 | 02:25 | 0.61 | 19:55 | 1.53 | 1.10 | 02:25 | 0.019 | 13:20 | 0.121 | 0.065 | 0.065 | |
| 5/20/2013 | 02:00 | 1.28 | 13:10 | 3.38 | 2.21 | 03:40 | 0.51 | 13:10 | 1.60 | 1.09 | 04:15 | 0.014 | 13:10 | 0.168 | 0.068 | 0.068 | |
| 5/21/2013 | 02:25 | 1.25 | 11:15 | 3.35 | 2.23 | 02:25 | 0.48 | 21:50 | 1.67 | 1.10 | 02:25 | 0.012 | 10:40 | 0.158 | 0.070 | 0.070 | |
| 5/22/2013 | 04:20 | 1.47 | 13:05 | 3.28 | 2.30 | 04:10 | 0.51 | 08:15 | 1.60 | 1.14 | 04:10 | 0.017 | 13:05 | 0.154 | 0.074 | 0.074 | |
| 5/23/2013 | 02:35 | 1.30 | 16:00 | 3.48 | 2.54 | 02:35 | 0.51 | 13:25 | 1.70 | 1.23 | 02:35 | 0.014 | 16:00 | 0.178 | 0.094 | 0.094 | |
| 5/24/2013 | 03:20 | 1.90 | 21:50 | 3.56 | 2.68 | 01:55 | 0.88 | 21:50 | 1.74 | 1.29 | 01:55 | 0.042 | 21:50 | 0.196 | 0.101 | 0.101 | |
| 5/25/2013 | 04:55 | 1.94 | 12:50 | 3.41 | 2.66 | 05:10 | 0.82 | 12:45 | 1.57 | 1.27 | 05:10 | 0.042 | 09:10 | 0.161 | 0.098 | 0.098 | |
| 5/26/2013 | 04:35 | 1.99 | 10:40 | 3.37 | 2.62 | 03:45 | 0.95 | 10:35 | 1.60 | 1.28 | 04:05 | 0.048 | 10:40 | 0.167 | 0.096 | 0.096 | |
| 5/27/2013 | 04:15 | 1.96 | 11:45 | 3.10 | 2.49 | 04:50 | 0.85 | 08:00 | 1.53 | 1.24 | 04:50 | 0.043 | 07:50 | 0.138 | 0.086 | 0.086 | |
| 5/28/2013 | 02:25 | 1.93 | 14:15 | 3.62 | 2.67 | 02:10 | 0.85 | 21:50 | 1.74 | 1.28 | 02:15 | 0.042 | 14:15 | 0.196 | 0.100 | 0.100 | |
| 5/29/2013 | 23:40 | 1.94 | 11:40 | 3.37 | 2.59 | 04:55 | 0.88 | 09:55 | 1.60 | 1.22 | 23:40 | 0.043 | 11:40 | 0.160 | 0.091 | 0.091 | |
| 5/30/2013 | 03:25 | 1.41 | 13:55 | 3.25 | 2.27 | 03:25 | 0.51 | 11:50 | 1.50 | 1.08 | 03:25 | 0.016 | 13:55 | 0.149 | 0.070 | 0.070 | |
| 5/31/2013 | 01:40 | 1.27 | 16:25 | 3.38 | 2.26 | 01:30 | 0.48 | 16:25 | 1.63 | 1.09 | 01:40 | 0.012 | 16:25 | 0.171 | 0.071 | 0.071 | |

## Report Summary For The Period 5/18/2013 - 5/31/2013

| | Depth (in) | Velocity (ft/s) | Quantity (MGD - Total MG) |
|---|---|---|---|
| Total | | | 1.155 |
| Avg | 2.43 | 1.18 | 0.083 |

## Site Commentary

### Site Information

| HAWT01 | |
|---|---|
| Pipe Dimensions | 12 " |
| Silt Level | 0.00" |

### Overview

Site HAWT01 functioned under normal conditions during the period Saturday, May 18, 2013 to Friday, May 31, 2013 . No surcharge conditions were experienced at this location. Review of the scattergraph shows that flow in this line remained free-flowing throughout the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Flow monitoring site CARS04 was located upstream of this location. Flow balances well with the upstream site.

### Observations

Average flow depth, velocity, and quantity data observed during Saturday, May 18, 2013 to Friday, May 31, 2013 , along with observed minimum and maximum data, are provided in the following table. In regards to depth, this site flows at 36.6% full at its recorded hourly peak at 4.40 inches and approximately 28.6% full during the typical hourly average depth of 3.43 inches.

| Observed Flow Conditions | | | |
|---|---|---|---|
| Item | Depth (in) | Velocity (ft/s) | Quantity (MGD) |
| Average | 3.43 | 1.69 | 0.214 |
| Minimum | 1.80 | 0.74 | 0.039 |
| Maximum | 5.04 | 2.45 | 0.442 |
| Time of Minimum | 5/21/2013 2:30 AM | 5/19/2013 2:30 AM | 5/21/2013 2:30 AM |
| Time of Maximum | 5/20/2013 9:10 AM | 5/21/2013 11:25 AM | 5/20/2013 9:10 AM |

### Data Quality

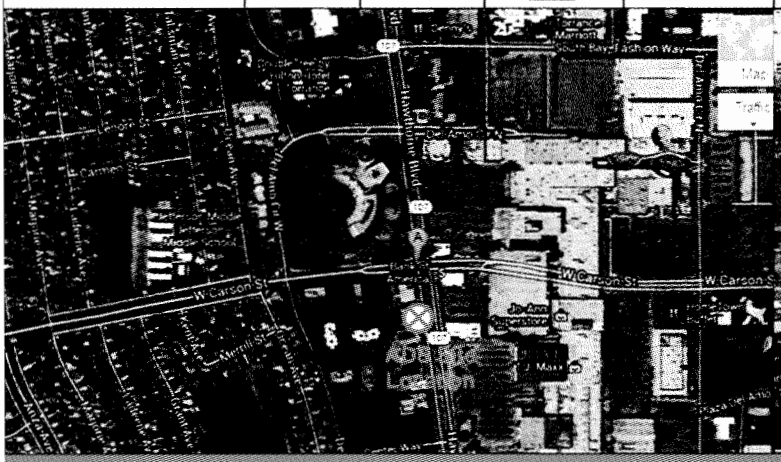
Data uptime observed during the Saturday, May 18, 2013 to the Friday, May 31, 2013 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

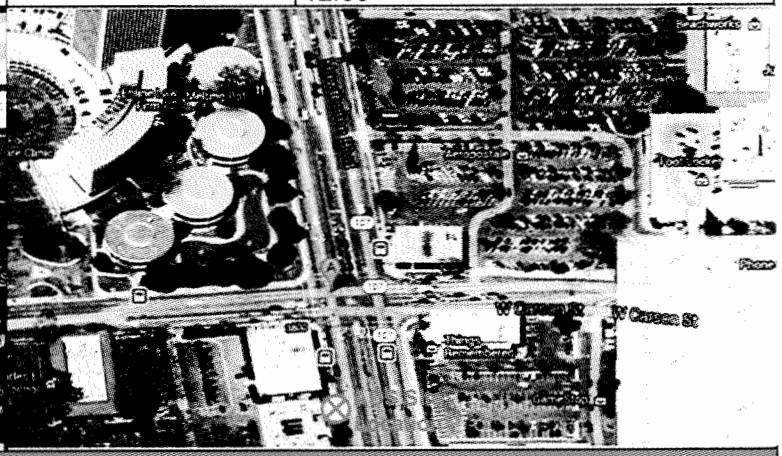
| Percent Uptime | |
|---|---|
| Depth (in) | 100 |
| Velocity (ft/s) | 100 |
| Quantity (MGD) | 100 |

# ADS Site Report

Quality Form

| | | | |
|---|---|---|---|
| **Project Name:** Torrence Tait | **City:** Torrance, CA | **Agency:** Torrance | **FM Initials:** SK |
| **Site Name:** HAWT01 | **Install Date:** 5/17/13 | **Monitor Type** | Peak Doppler |
| **ess/Location:** Hawthorne Blvd and W Carson St. | | **Monitor Model** | 3600 |
| | | **Data Acquisition** | Manual Collect |
| | | **Manhole ID** | N/A |
| **Access:** Drive | **Type of System:** Sanitary [X] Storm [ ] Combined [ ] | **Pipe Height:** | 12.00 " |
| | | **Pipe Width:** | 12.00 " |




## Investigation Information:

| | |
|---|---|
| **Date/Time of Investigation:** | 5/17/13 |
| **Site Hydraulics:** | Good straight through flow |
| **Upstream Input: (L/S, P/S)** | DNI |
| **eam Manhole:** | DNI |
| **wnstream Manhole:** | DNI |
| **Depth of Flow:** | 3.88 " +/- 0.13" |
| **Range (Air DOF):** | +/- |
| **Peak Velocity:** | 2.39 fps |
| **Silt:** | 0.00 Inches |

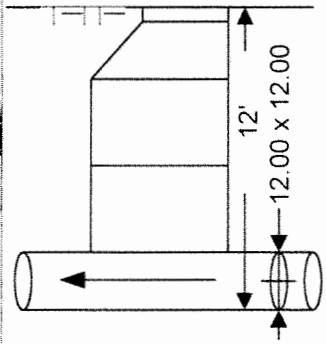
## Manhole Information:

| | | | | |
|---|---|---|---|---|
| **Manhole Depth:** | 12' | | | |
| **Manhole Material / Condition** | Precast/OK | | | |
| **Pipe Material / Condition:** | VCP/Good | | | |
| **Land Use:** | Residential [x] | Commercial [ ] | Industrial [ ] | Trunk [ ] |
| **Oxygen:** 20.9 | **H2S:** 0 | **LEL:** 0 | **CO:** 0 | |

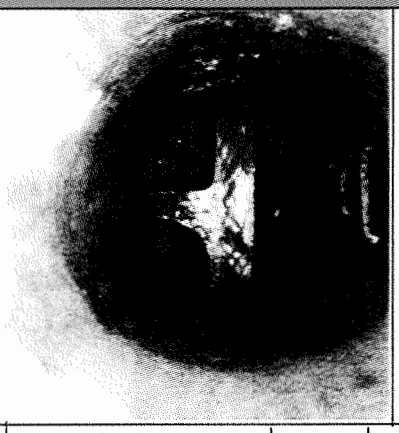
**Safety Notes:**

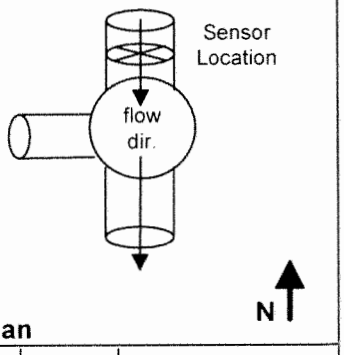
2 man crew required.

## Other Information:




Cross Section






Plan

| Installation Information | | Backup | Yes | No | ? | Distance |
|---|---|---|---|---|---|---|
| Installation Type: | Ring | Trunk | [ ] | [x] | [ ] | |
| Sensors Devices: | Ultrasonic / Pressure/ Velocity | Lift / Pump Station | [ ] | [x] | [ ] | |
| Surcharge Height: | 0 | WWTP | [ ] | [x] | [ ] | |
| Gauge Zone: | | Other | [ ] | [x] | [ ] | |

## Additional Site Information / Comments:

**Standard Traffic Control with No Safety Concerns**

# SCATTERGRAPH REPORT

HAWT01

**Flow Monitor**

**HAWT01**

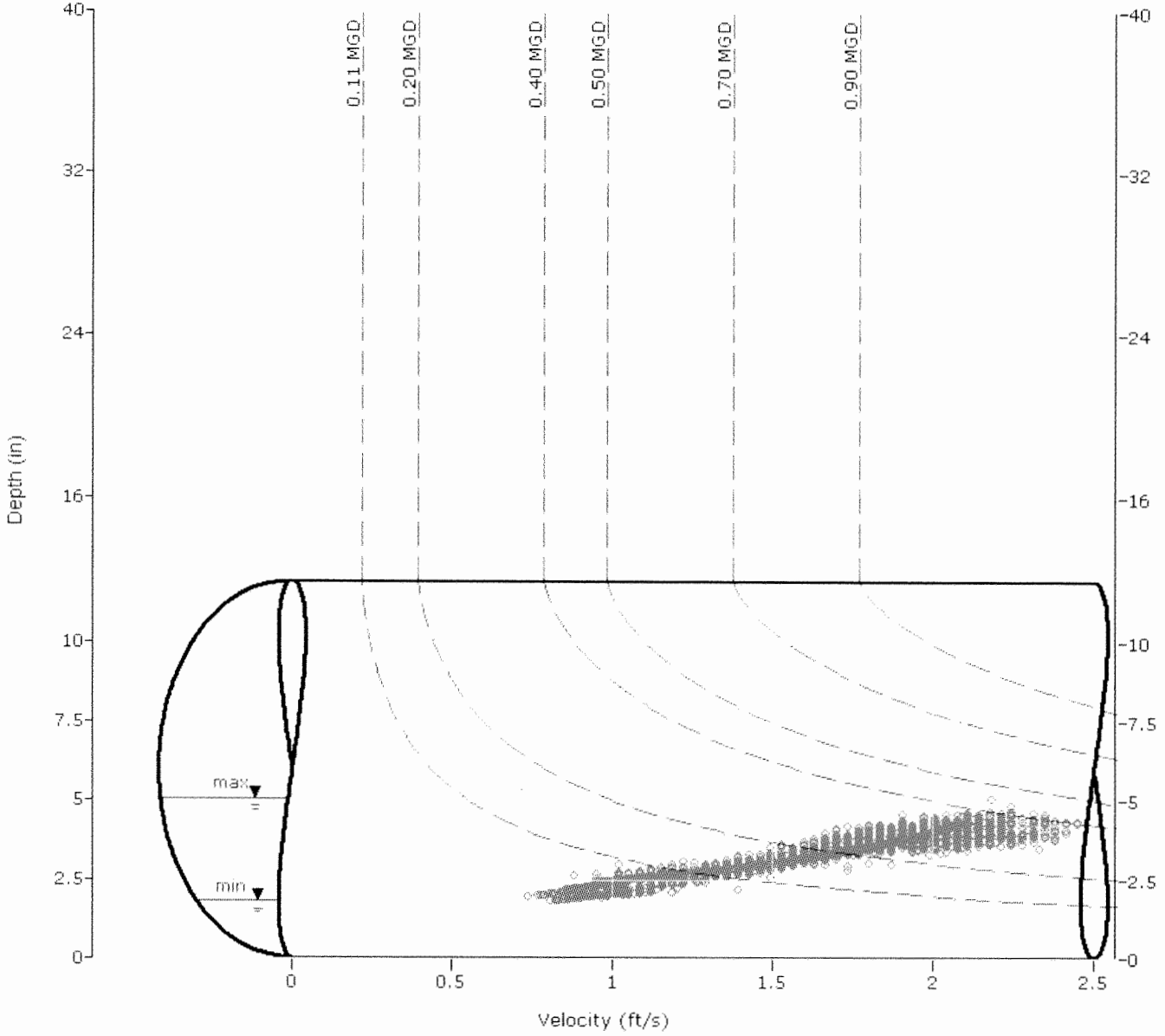
Pipe Height
12.00 in

**Report Period**

5/18/2013
To
5/31/2013

**Legend**

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth




ADS ENVIRONMENTAL SERVICES

# HYDROGRAPH REPORT

HAWT01

**Flow Monitor**

**HAWT01**

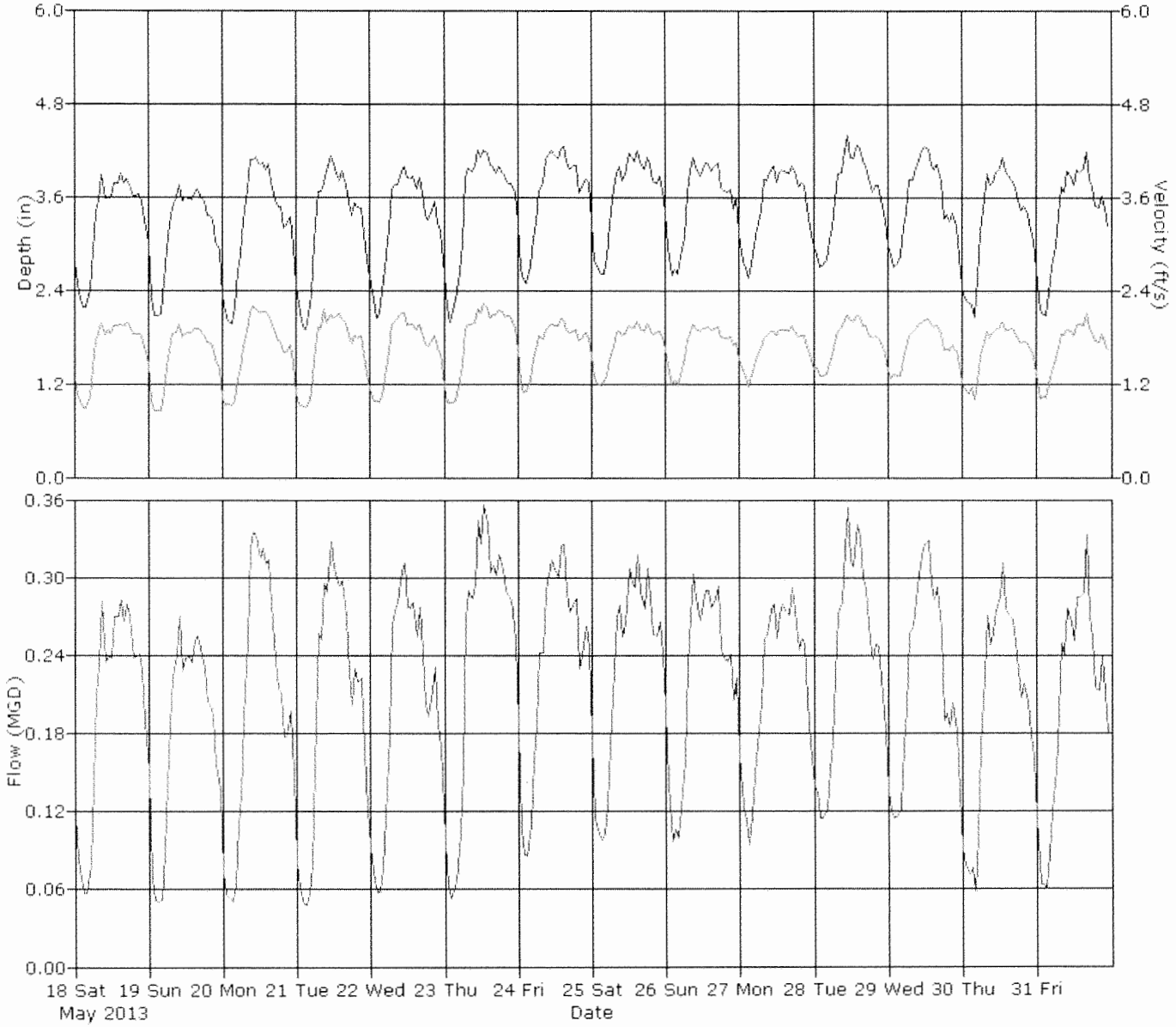
Pipe Height
12.00 in

**Report Period**

5/18/2013
To
5/31/2013

**Legend**

- Depth
- Velocity
- Quantity



## Daily Tabular Report

| Date | Depth (in) | | | | | Velocity (ft/s) | | | | | Quantity (MGD - Total MG) | | | | | | Rain (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Total | Total |
| 5/18/2013 | 02:50 | 2.04 | 15:05 | 4.29 | 3.30 | 02:50 | 0.82 | 18:30 | 2.21 | 1.65 | 02:50 | 0.047 | 15:05 | 0.345 | 0.200 | 0.200 | |
| 5/19/2013 | 02:30 | 1.94 | 09:15 | 4.02 | 3.16 | 02:30 | 0.74 | 16:55 | 2.18 | 1.58 | 02:30 | 0.039 | 10:05 | 0.306 | 0.180 | 0.180 | |
| 5/20/2013 | 03:55 | 1.85 | 09:10 | 5.04 | 3.27 | 03:55 | 0.85 | 10:30 | 2.38 | 1.66 | 03:55 | 0.042 | 09:10 | 0.442 | 0.203 | 0.203 | |
| 5/21/2013 | 02:30 | 1.80 | 10:45 | 4.39 | 3.24 | 02:30 | 0.81 | 11:25 | 2.45 | 1.65 | 02:30 | 0.039 | 11:25 | 0.401 | 0.200 | 0.200 | |
| 5/22/2013 | 02:40 | 1.95 | 12:50 | 4.39 | 3.30 | 03:15 | 0.87 | 10:00 | 2.38 | 1.67 | 02:40 | 0.049 | 10:30 | 0.363 | 0.203 | 0.203 | |
| 5/23/2013 | 02:40 | 1.89 | 11:50 | 4.61 | 3.51 | 01:30 | 0.87 | 13:45 | 2.45 | 1.79 | 02:40 | 0.045 | 11:45 | 0.400 | 0.239 | 0.239 | |
| 5/24/2013 | 03:20 | 2.37 | 15:50 | 4.63 | 3.65 | 02:45 | 0.95 | 14:45 | 2.21 | 1.73 | 02:45 | 0.069 | 15:50 | 0.394 | 0.236 | 0.236 | |
| 5/25/2013 | 03:35 | 2.52 | 18:15 | 4.63 | 3.64 | 04:50 | 0.95 | 12:50 | 2.25 | 1.72 | 04:50 | 0.080 | 18:15 | 0.405 | 0.232 | 0.232 | |
| 5/26/2013 | 02:40 | 2.43 | 17:05 | 4.59 | 3.57 | 02:50 | 0.88 | 16:55 | 2.21 | 1.72 | 02:50 | 0.073 | 17:05 | 0.395 | 0.224 | 0.224 | |
| 5/27/2013 | 04:15 | 2.46 | 14:15 | 4.23 | 3.53 | 03:35 | 0.95 | 14:00 | 2.08 | 1.70 | 03:35 | 0.075 | 14:10 | 0.331 | 0.219 | 0.219 | |
| 5/28/2013 | 02:20 | 2.53 | 11:45 | 4.55 | 3.63 | 00:55 | 1.02 | 13:05 | 2.31 | 1.76 | 02:55 | 0.080 | 15:25 | 0.396 | 0.236 | 0.236 | |
| 5/29/2013 | 02:30 | 2.60 | 13:00 | 4.60 | 3.52 | 01:35 | 1.02 | 10:10 | 2.35 | 1.70 | 04:05 | 0.089 | 10:10 | 0.415 | 0.219 | 0.219 | |
| 5/30/2013 | 04:55 | 1.92 | 13:55 | 4.45 | 3.32 | 04:10 | 0.83 | 13:55 | 2.28 | 1.64 | 04:10 | 0.048 | 13:55 | 0.391 | 0.199 | 0.199 | |
| 5/31/2013 | 01:55 | 1.95 | 16:30 | 4.42 | 3.34 | 01:50 | 0.77 | 16:50 | 2.35 | 1.66 | 01:50 | 0.042 | 16:50 | 0.391 | 0.204 | 0.204 | |

## Report Summary For The Period 5/18/2013 - 5/31/2013

| | Depth (in) | Velocity (ft/s) | Quantity (MGD - Total MG) |
|---|---|---|---|
| Total | | | 2.996 |
| Avg | 3.43 | 1.69 | 0.214 |

## Site Commentary

### Site Information

| HAWT03 | |
|---|---|
| Pipe Dimensions | 12 " |
| Silt Level | 0.00" |

### Overview

Site HAWT03 functioned under normal conditions during the period Saturday, May 18, 2013 to Friday, May 31, 2013 . No surcharge conditions were experienced at this location. Review of the scattergraph shows that flow in this line remained free-flowing throughout the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Flow monitoring site HAWT01 was located immediately upstream of this location. Flow balances well with the upstream site.

### Observations

Average flow depth, velocity, and quantity data observed during Saturday, May 18, 2013 to Friday, May 31, 2013 , along with observed minimum and maximum data, are provided in the following table. In regards to depth, this site flows at 37.6% full at its recorded hourly peak at 4.51 inches and approximately 30.3% full during the typical hourly average depth of 3.64 inches.

| Observed Flow Conditions | | | |
|---|---|---|---|
| Item | Depth (in) | Velocity (ft/s) | Quantity (MGD) |
| Average | 3.64 | 1.71 | 0.231 |
| Minimum | 1.97 | 0.77 | 0.045 |
| Maximum | 4.90 | 2.57 | 0.424 |
| Time of Minimum | 5/20/2013 4:10 AM | 5/20/2013 4:00 AM | 5/20/2013 4:00 AM |
| Time of Maximum | 5/23/2013 12:00 PM | 5/27/2013 11:50 AM | 5/28/2013 11:25 AM |

### Data Quality

Data uptime observed during the Saturday, May 18, 2013 to the Friday, May 31, 2013 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

| Percent Uptime | |
|---|---|
| Depth (in) | 100 |
| Velocity (ft/s) | 100 |
| Quantity (MGD) | 100 |

# ADS Site Report

Quality Form

| | | | |
|---|---|---|---|
| **Project Name:** Torrance Tait | **City:** Torrance, CA | **Agency:** Torrance | **FM Initials:** SK |
| **Site Name:** HAWT03 | **Install Date:** 5/17/13 | **Monitor Type** | Peak Doppler |
| | | **Monitor Model** | 3600 |
| **ess/Location:** | Hawthorne Blvd and W Sepulveda Blvd | **Data Acquisition** | Manual Collect |
| | | **Manhole ID** | N/A |
| **Access:** Drive | **Type of System:** Sanitary [X] Storm [ ] Combined [ ] | **Pipe Height:** | 12.00 " |
| | | **Pipe Width:** | 12.00 " |


## Investigation Information:

| | |
|---|---|
| **Date/Time of Investigation:** | 5/17/13 |
| **Site Hydraulics:** | Good straight through flow |
| **Upstream Input: (L/S, P/S)** | DNI |
| **eam Manhole:** | DNI |
| **wnstream Manhole:** | DNI |
| **Depth of Flow:** | 4.00 " +/- 0.13" |
| **Range (Air DOF):** | +/- |
| **Peak Velocity:** | 2.58 fps |
| **Silt:** | 0.00 Inches |

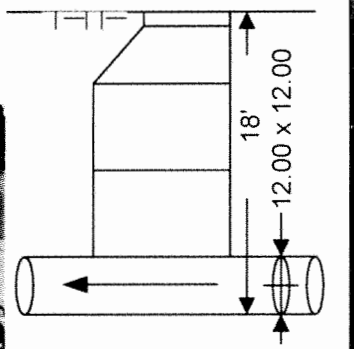
## Manhole Information:

| | | | | |
|---|---|---|---|---|
| **Manhole Depth:** | 18' | | | |
| **Manhole Material / Condition** | Precast/OK | | | |
| **Pipe Material / Condition:** | VCP/Good | | | |
| **Land Use:** | Residential [X] | Commercial [ ] | Industrial [ ] | Trunk [ ] |
| **Oxygen:** 20.9 | **H2S:** 0 | **LEL:** 0 | **CO:** 0 | |

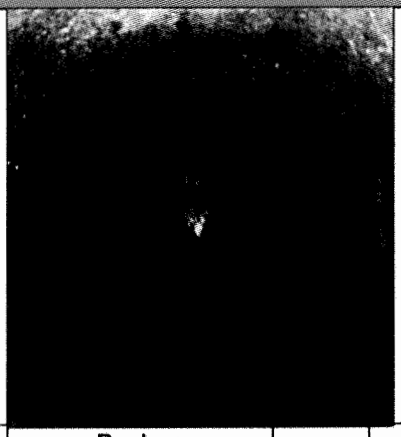
**Safety Notes:**

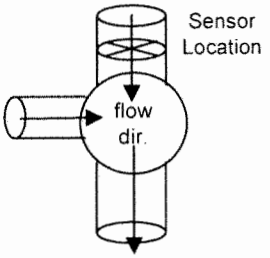
2 man crew required.

## Other Information:




Cross Section






Plan

| Installation Information | |
|---|---|
| Installation Type: | Ring |
| Sensors Devices: | Ultrasonic / Pressure/ Velocity |
| Surcharge Height: | 0 |
| Gauge Zone: | |

| Backup | Yes | No | ? | Distance |
|---|---|---|---|---|
| Trunk | [ ] | [x] | [ ] | |
| Lift / Pump Station | [ ] | [x] | [ ] | |
| WWTP | [ ] | [x] | [ ] | |
| Other | [ ] | [X] | [ ] | |

## Additional Site Information / Comments:

**Standard Traffic Control with No Safety Concerns**

# SCATTERGRAPH REPORT

HAWT03

**Flow Monitor**

**HAWT03**

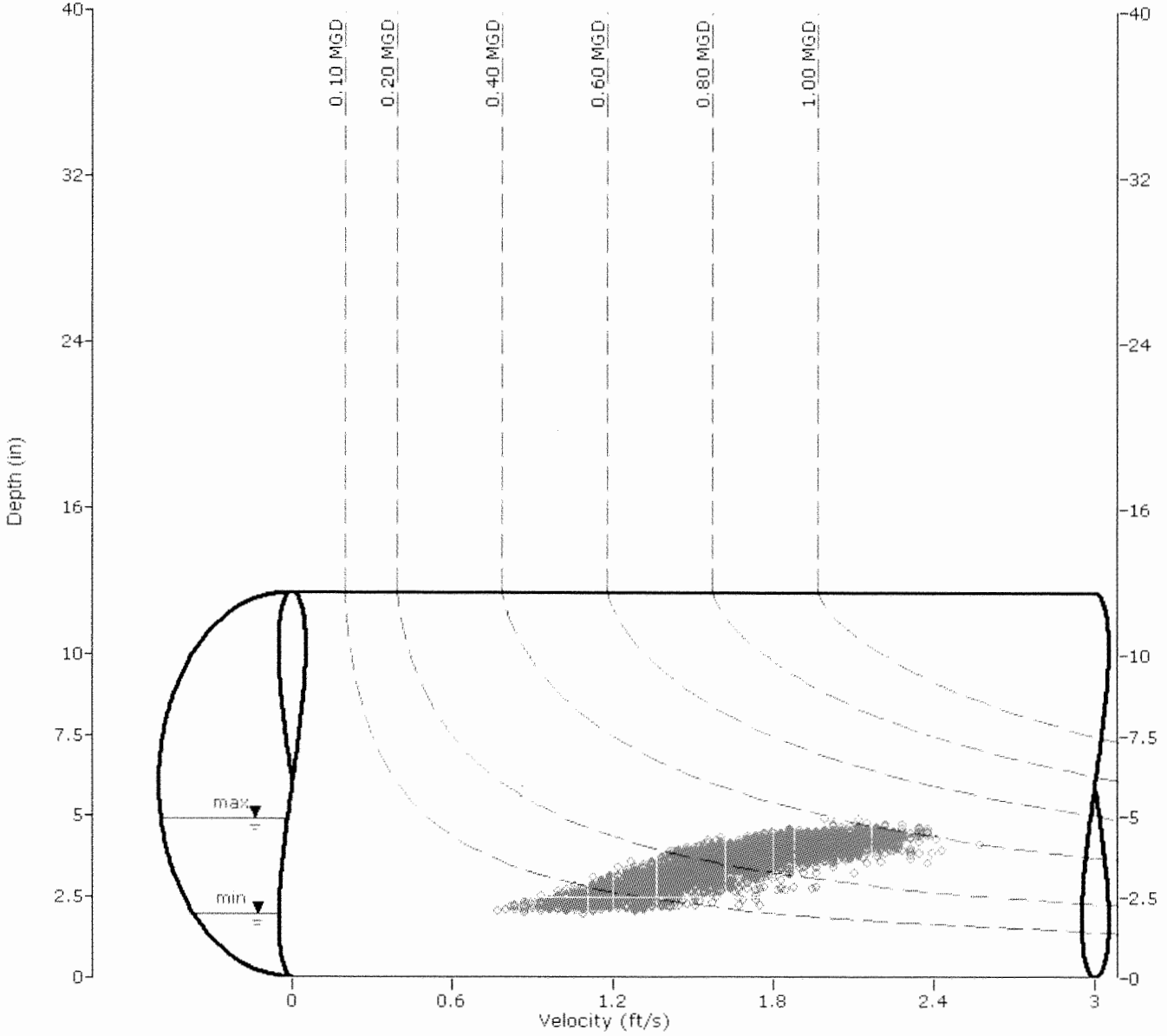
Pipe Height
12.00 in

**Report Period**

5/18/2013
To
5/31/2013

**Legend**

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth




ADS ENVIRONMENTAL SERVICES

# HYDROGRAPH REPORT

HAWT03

**Flow Monitor**

**HAWT03**

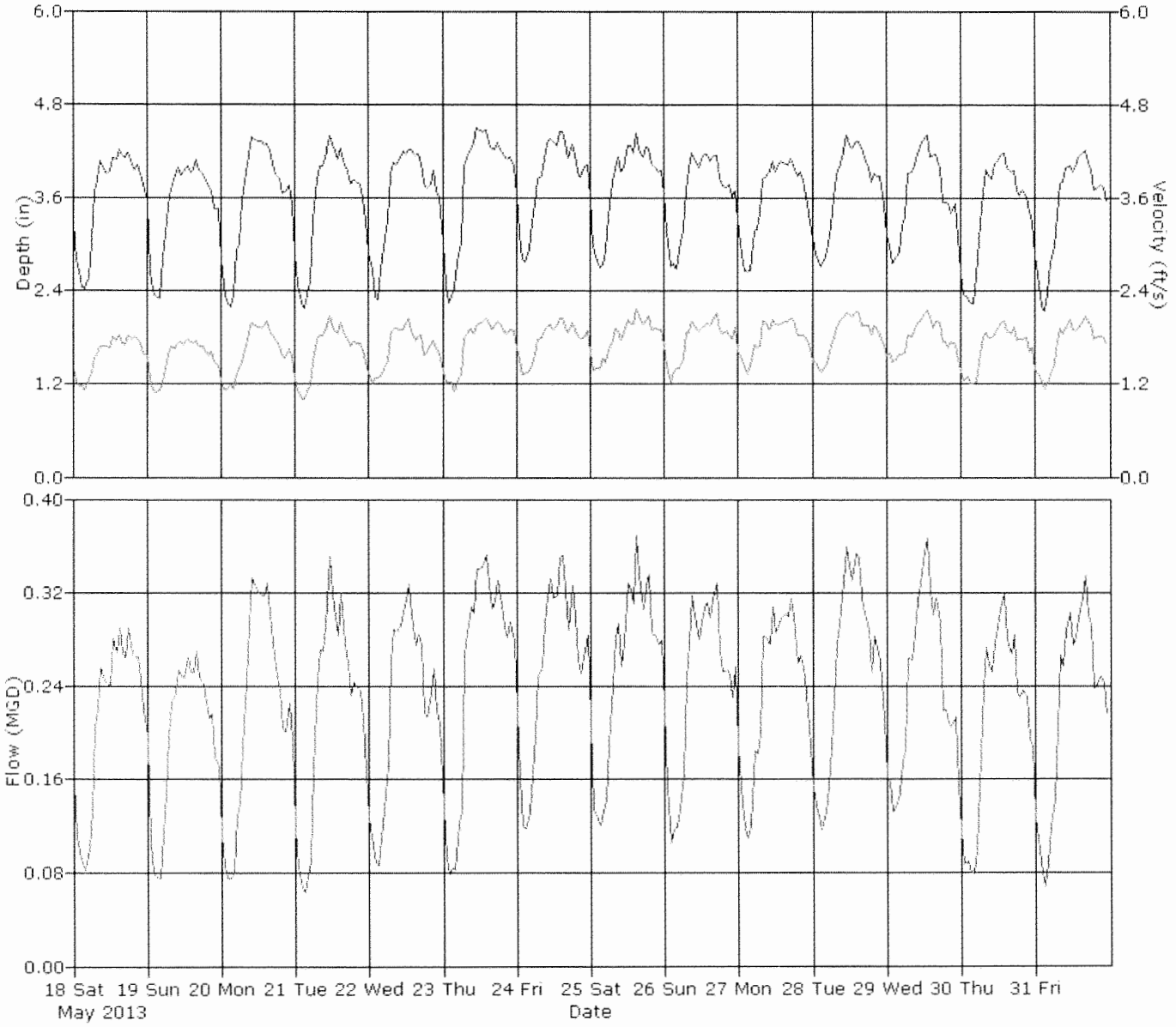
Pipe Height
12.00 in

**Report Period**

5/18/2013
To
5/31/2013

**Legend**

- Depth
- Velocity
- Quantity




ADS ENVIRONMENTAL SERVICES

## Daily Tabular Report

| Date | Depth (in) | | | | | Velocity (ft/s) | | | | | Quantity (MGD - Total MG) | | | | | | Rain (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Total | Total |
| 5/18/2013 | 04:55 | 2.28 | 15:45 | 4.52 | 3.63 | 04:40 | 0.96 | 14:10 | 2.12 | 1.58 | 04:55 | 0.067 | 19:15 | 0.353 | 0.213 | 0.213 | |
| 5/19/2013 | 02:45 | 2.13 | 16:10 | 4.37 | 3.50 | 02:40 | 0.87 | 17:35 | 2.19 | 1.54 | 02:40 | 0.056 | 16:10 | 0.349 | 0.197 | 0.197 | |
| 5/20/2013 | 04:10 | 1.97 | 09:25 | 4.78 | 3.58 | 04:00 | 0.77 | 09:20 | 2.38 | 1.61 | 04:00 | 0.045 | 09:20 | 0.413 | 0.218 | 0.218 | |
| 5/21/2013 | 02:45 | 2.07 | 15:35 | 4.59 | 3.55 | 02:35 | 0.84 | 11:10 | 2.22 | 1.61 | 03:45 | 0.049 | 11:15 | 0.387 | 0.216 | 0.216 | |
| 5/22/2013 | 03:55 | 2.17 | 12:05 | 4.60 | 3.62 | 03:55 | 0.84 | 13:00 | 2.25 | 1.66 | 03:55 | 0.052 | 12:05 | 0.386 | 0.224 | 0.224 | |
| 5/23/2013 | 03:00 | 2.10 | 12:00 | 4.90 | 3.78 | 04:00 | 0.88 | 14:25 | 2.28 | 1.72 | 04:00 | 0.058 | 11:50 | 0.415 | 0.250 | 0.250 | |
| 5/24/2013 | 03:35 | 2.56 | 16:00 | 4.72 | 3.87 | 04:20 | 1.09 | 12:05 | 2.28 | 1.77 | 04:20 | 0.096 | 16:00 | 0.424 | 0.258 | 0.258 | |
| 5/25/2013 | 05:00 | 2.54 | 16:05 | 4.62 | 3.79 | 04:25 | 1.06 | 19:10 | 2.38 | 1.81 | 04:25 | 0.091 | 19:10 | 0.411 | 0.257 | 0.257 | |
| 5/26/2013 | 02:50 | 2.56 | 17:15 | 4.47 | 3.68 | 04:20 | 1.01 | 07:30 | 2.38 | 1.78 | 04:20 | 0.081 | 17:15 | 0.377 | 0.242 | 0.242 | |
| 5/27/2013 | 03:45 | 2.47 | 16:55 | 4.25 | 3.61 | 04:00 | 1.00 | 11:50 | 2.57 | 1.80 | 04:00 | 0.076 | 11:50 | 0.393 | 0.238 | 0.238 | |
| 5/28/2013 | 02:55 | 2.47 | 11:25 | 4.63 | 3.72 | 03:05 | 1.19 | 14:15 | 2.41 | 1.82 | 03:05 | 0.095 | 11:25 | 0.424 | 0.253 | 0.253 | |
| 5/29/2013 | 02:45 | 2.61 | 13:10 | 4.58 | 3.64 | 02:30 | 1.11 | 13:10 | 2.38 | 1.78 | 02:30 | 0.093 | 13:10 | 0.424 | 0.238 | 0.238 | |
| 5/30/2013 | 03:40 | 2.10 | 14:05 | 4.55 | 3.44 | 04:30 | 0.90 | 17:50 | 2.27 | 1.67 | 04:30 | 0.055 | 14:05 | 0.391 | 0.211 | 0.211 | |
| 5/31/2013 | 04:05 | 2.04 | 16:40 | 4.59 | 3.49 | 03:55 | 0.93 | 17:55 | 2.43 | 1.71 | 04:05 | 0.053 | 16:40 | 0.420 | 0.222 | 0.222 | |

## Report Summary For The Period 5/18/2013 - 5/31/2013

| | Depth (in) | Velocity (ft/s) | Quantity (MGD - Total MG) |
|---|---|---|---|
| Total | | | 3.236 |
| Avg | 3.64 | 1.71 | 0.231 |

MODEL INPUT

Project Location : City of Torrance  Project ID : Model Line #24
Report Date : 09-10-91  Prepared By: ALR
Selected Basin : MOD24  Design Capacity: (Specified by Design File)

| Basin ID | Upstream Node | Downstream Node | U/S Invert & Lid Elev. | D/S Invert & Lid Elev. | Pipe Length (ft.) | Pipe Diameter (in.) | Slope | Manning n | Street & Comments |
|---|---|---|---|---|---|---|---|---|---|
| S003E | 055-5-01 | 055-5-02 | 88.20<br>96.85 | 83.91<br>93.75 | 322.5 | 8.0 | .01330 | .013 | HAWTHORNE BLVD |
| S003E | 055-5-02 | 062-2-01 | 83.80<br>93.75 | 79.66<br>91.05 | 322.5 | 8.0 | .01284 | .013 | HAWTHORNE BLVD |
| S003E | 062-2-01 | 062-2-02 | 79.66<br>91.05 | 75.58<br>88.55 | 322.5 | 8.0 | .01265 | .013 | HAWTHORNE BLVD |
| S003E | 062-2-02 | 062-2-07 | 75.48<br>88.55 | 71.65<br>82.00 | 302.5 | 8.0 | .01266 | .013 | HAWTHORNE BLVD |
| S003F | 062-2-04 | 062-2-05 | 70.77<br>81.40 | 70.67<br>81.75 | 33.3 | 12.0 | .00300 | .013 | HAWTHORNE BLVD |
| S003F | 062-2-05 | 062-5-01 | 73.62<br>81.75 | 69.90<br>80.95 | 330.0 | 12.0 | .00218 | .013 | HAWTHORNE BLVD |
| S003E | 062-2-06 | 062-2-04 | 71.16<br>84.25 | 70.82<br>81.40 | 78.0 | 10.0 | .00436 | .013 | HAWTHORNE BLVD |
| S003E | 062-2-07 | 062-2-06 | 71.60<br>82.00 | 71.45<br>84.25 | 70.0 | 10.0 | .00214 | .013 | HAWTHORNE BLVD |
| S003F | 062-5-01 | 062-5-02 | 69.84<br>80.95 | 69.22<br>81.45 | 310.0 | 12.0 | .00200 | .013 | HAWTHORNE BLVD |
| S003F | 062-5-02 | 062-5-03 | 69.10<br>81.45 | 68.54<br>81.85 | 310.0 | 12.0 | .00181 | .013 | HAWTHORNE BLVD |
| S003F | 062-5-03 | 069-2-01 | 68.35<br>81.85 | 67.85<br>82.65 | 310.0 | 12.0 | .00161 | .013 | HAWTHORNE BLVD |
| S003F | 069-2-01 | 069-2-02 | 67.61<br>82.65 | 66.86<br>84.03 | 310.0 | 12.0 | .00242 | .013 | SEPULVEDA BLVD |
| S003F | 069-2-02 | 069-2-03 | 66.86<br>84.03 | 66.12<br>84.55 | 310.0 | 12.0 | .00239 | .013 | SEPULVEDA BLVD |
| S003F | 069-2-03 | 069-5-01 | 66.12<br>84.55 | 65.80<br>83.50 | 312.3 | 12.0 | .00102 | .013 | SEPULVEDA BLVD |

INTERFLO Steady State Sewer Flow Model
Analysis for File: C:\INTERFLO\TORRANCE\MODELS\TORMOD24.DAT


09-17-91
1:20 pm

PIPE IMPROVEMENTS REPORT

Project Location : City of Torrance  Project ID : Model Line #24
Report Date : 09-10-91  Prepared By: ALR
Selected Basin : MOD24  Design Capacity: (Specified by Design File)

| Upstream Node / Downstream Node | Length,ft. / Slope | Diam.,in. / Manning n | Routed Flow Depth (in.) | Routed Flow Velocity (fps) | Routed Flow (GPD) | Open Channel Capacity (GPD) | Capacity Used (%) | Required Improvement Pipe Diameters (in.) Parallel | Required Improvement Pipe Diameters (in.) Replacement | Replacement Velocity (fps) | Flow Split (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 055-5-01 | 322.5 | 8.0 | 1.0 | 1.834 | 29,498 | 900,350 | 3 | | | | |
| 055-5-02 | .01330 | .013 | | | | | | | | | |
| 055-5-02 | 322.5 | 8.0 | 1.2 | 2.044 | 44,247 | 884,469 | 5 | | | | |
| 062-2-01 | .01284 | .013 | | | | | | | | | |
| 062-2-01 | 322.5 | 8.0 | 1.4 | 2.215 | 58,996 | 878,037 | 7 | | | | |
| 062-2-02 | .01265 | .013 | | | | | | | | | |
| 062-2-02 | 302.5 | 8.0 | 1.6 | 2.366 | 73,745 | 878,383 | 8 | | | | |
| 062-2-07 | .01266 | .013 | | | | | | | | | |
| 062-2-04 | 33.3 | 12.0 | 2.9 | 1.715 | 163,608 | 1,261,252 | 13 | | | | |
| 062-2-05 | .00300 | .013 | | | | | | | | | |
| 062-2-05 | 330.0 | 12.0 | 3.8 | 1.701 | 237,335 | 1,075,062 | 22 | | | | |
| 062-5-01 | .00218 | .013 | | | | | | | | | |
| 062-2-06 | 78.0 | 10.0 | 1.9 | 1.582 | 73,745 | 934,472 | 8 | | | | |
| 062-2-04 | .00436 | .013 | | | | | | | | | |
| 062-2-07 | 70.0 | 10.0 | 2.3 | 1.231 | 73,745 | 655,195 | 11 | | | | |
| 062-2-06 | .00214 | .013 | | | | | | | | | |
| 062-5-01 | 310.0 | 12.0 | 4.0 | 1.674 | 250,889 | 1,029,293 | 24 | | | | |
| 062-5-02 | .00200 | .013 | | | | | | | | | |
| 062-5-02 | 310.0 | 12.0 | 4.3 | 1.638 | 264,443 | 978,222 | 27 | | | | |
| 062-5-03 | .00181 | .013 | | | | | | | | | |
| 062-5-03 | 310.0 | 12.0 | 4.5 | 1.594 | 277,998 | 924,333 | 30 | | | | |
| 069-2-01 | .00161 | .013 | | | | | | | | | |
| 069-2-01 | 310.0 | 12.0 | 4.2 | 1.870 | 291,552 | 1,132,072 | 26 | | | | |
| 069-2-02 | .00242 | .013 | | | | | | | | | |
| 069-2-02 | 310.0 | 12.0 | 4.3 | 1.885 | 305,106 | 1,124,499 | 27 | | | | |
| 069-2-03 | .00239 | .013 | | | | | | | | | |
| 069-2-03 | 312.3 | 12.0 | 5.5 | 1.400 | 318,761 | 736,738 | 43 | | | | |
| 069-5-01 | .00102 | .013 | | | | | | | | | |

HAWTO1

HAWTO3

INTERFLO Steady State Sewer Flow Model
Analysis for File: C:\INTERFLO\TORRANCE\MODELS\TORMOD24.DAT


09-17-91
1:20 pm

FLOW SUMMARY

Project Location : City of Torrance  Project ID : Model Line #24
Report Date : 09-10-91  Prepared By: ALR
Selected Basin : MOD24  Design Capacity: (Specified by Design File)

| Basin | (GPD) Average Flow | Peak Flow | Linear Footage |
|---|---|---|---|
| S003E | | Factor: 1.00 | 1,418 |
| Point Sources | 73,745 | 73,745 | |
| | 73,745 | 73,745 | |
| S003F | | Factor: 1.00 | 2,226 |
| Measured Flow | 97,311 | 97,311 | |
| Point Sources | 147,705 | 147,705 | |
| | 245,016 | 245,016 | |
| | | 318,761 | 3,644 |

INTERFLO Steady State Sewer Flow Model
Analysis for File: C:\INTERFLO\TORRANCE\MODELS\TORMOD24.DAT



HYDRAULIC GRADELINE REPORT

09-17-91
1:20 pm

Project Location : City of Torrance  Project ID : Model Line #24
Report Date : 09-10-91  Prepared By: ALR
Selected Basin : MOD24  Design Capacity: (Specified by Design File)

| Node ID | Routed Flow (GPD) | Calculated HGL (ft.) | Lid Elevation (ft.) | Warning |
|---|---|---|---|---|
| 055-5-01 | 29,498 | 88.28 | 96.85 | |
| 055-5-02 | 44,247 | 83.90 | 93.75 | |
| 062-2-01 | 58,996 | 79.78 | 91.05 | |
| 062-2-02 | 73,745 | 75.61 | 88.55 | |
| 062-2-04 | 163,608 | 71.01 | 81.40 | |
| 062-2-05 | 237,335 | 70.94 | 81.75 | |
| 062-2-06 | 73,745 | 71.32 | 84.25 | |
| 062-2-07 | 73,745 | 71.79 | 82.00 | |
| 062-5-01 | 250,889 | 70.18 | 80.95 | |
| 062-5-02 | 264,443 | 69.46 | 81.45 | |
| 062-5-03 | 277,998 | 68.73 | 81.85 | |
| 069-2-01 | 291,552 | 67.96 | 82.65 | |
| 069-2-02 | 305,106 | 67.22 | 84.03 | |
| 069-2-03 | 318,761 | 66.58 | 84.55 | |
| 069-5-01 | 318,761 | 66.09 | 83.50 | |

POINT SOURCE FLOWS

Project Location : City of Torrance Project ID : Model Line #24
Report Date : 09-10-91 Prepared By: ALR
Selected Basin : MOD24 Design Capacity: (Specified by Design File)

| Node ID | Description | Average Flow (GPD) | Peak Flow (GPD) |
|---|---|---|---|
| 055-5-01 | 30% S003E | 29,498 | 29,498.00 |
| 055-5-02 | 15% S003E | 14,749 | 14,749.00 |
| 062-2-01 | 15% S003E | 14,749 | 14,749.00 |
| 062-2-02 | 15% S003E | 14,749 | 14,749.00 |
| 062-2-04 | S0038 | 88,407 | 88,407.00 |
| 062-2-05 | S003A | 59,298 | 59,298.00 |

# Worksheet for HAWT01 MASTER PLAN

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00240 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 0.37 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.31 | ft |
| Flow Area | 0.21 | $ft^2$ |
| Wetted Perimeter | 1.18 | ft |
| Hydraulic Radius | 0.18 | ft |
| Top Width | 0.93 | ft |
| Critical Depth | 0.25 | ft |
| Percent Full | 31.1 | % |
| Critical Slope | 0.00566 | ft/ft |
| Velocity | 1.76 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Energy | 0.36 | ft |
| Froude Number | 0.65 | |
| Maximum Discharge | 1.88 | $ft^3/s$ |
| Discharge Full | 1.75 | $ft^3/s$ |
| Slope Full | 0.00011 | ft/ft |
| Flow Type | SubCritical | |

# Worksheet for HAWT01 MASTER PLAN

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 31.13 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.31 | ft |
| Critical Depth | 0.25 | ft |
| Channel Slope | 0.00240 | ft/ft |
| Critical Slope | 0.00566 | ft/ft |

# Cross Section for HAWT01 MASTER PLAN

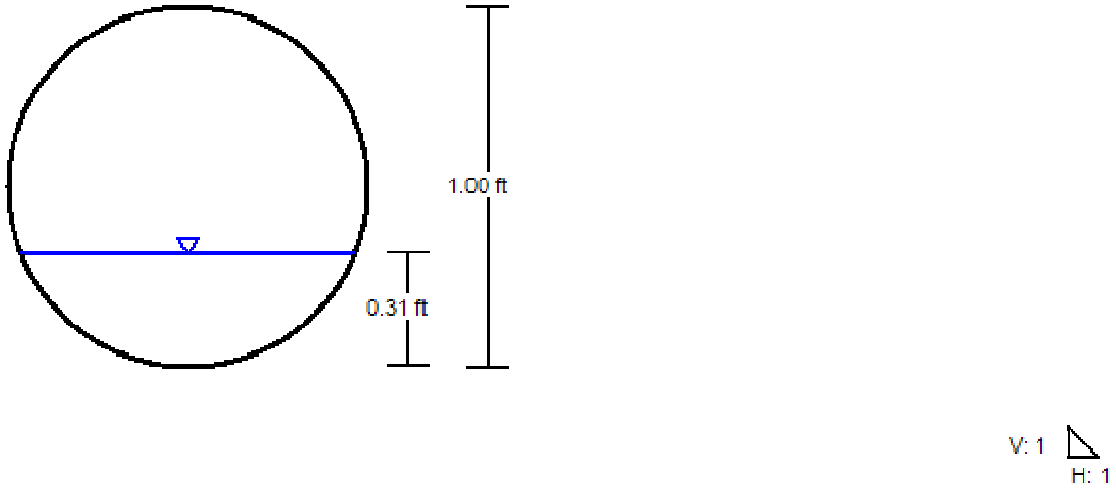
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00240 | ft/ft |
| Normal Depth | 0.31 | ft |
| Diameter | 1.00 | ft |
| Discharge | 0.37 | ft³/s |

## Cross Section Image



# Worksheet for HAWT03 MASTER PLAN

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00240 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 0.47 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.36 | ft |
| Flow Area | 0.25 | $ft^2$ |
| Wetted Perimeter | 1.28 | ft |
| Hydraulic Radius | 0.20 | ft |
| Top Width | 0.96 | ft |
| Critical Depth | 0.28 | ft |
| Percent Full | 35.5 | % |
| Critical Slope | 0.00563 | ft/ft |
| Velocity | 1.89 | ft/s |
| Velocity Head | 0.06 | ft |
| Specific Energy | 0.41 | ft |
| Froude Number | 0.65 | |
| Maximum Discharge | 1.88 | $ft^3/s$ |
| Discharge Full | 1.75 | $ft^3/s$ |
| Slope Full | 0.00018 | ft/ft |
| Flow Type | SubCritical | |

# Worksheet for HAWT03 MASTER PLAN

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 35.53 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.36 | ft |
| Critical Depth | 0.28 | ft |
| Channel Slope | 0.00240 | ft/ft |
| Critical Slope | 0.00563 | ft/ft |

# Cross Section for HAWT03 MASTER PLAN

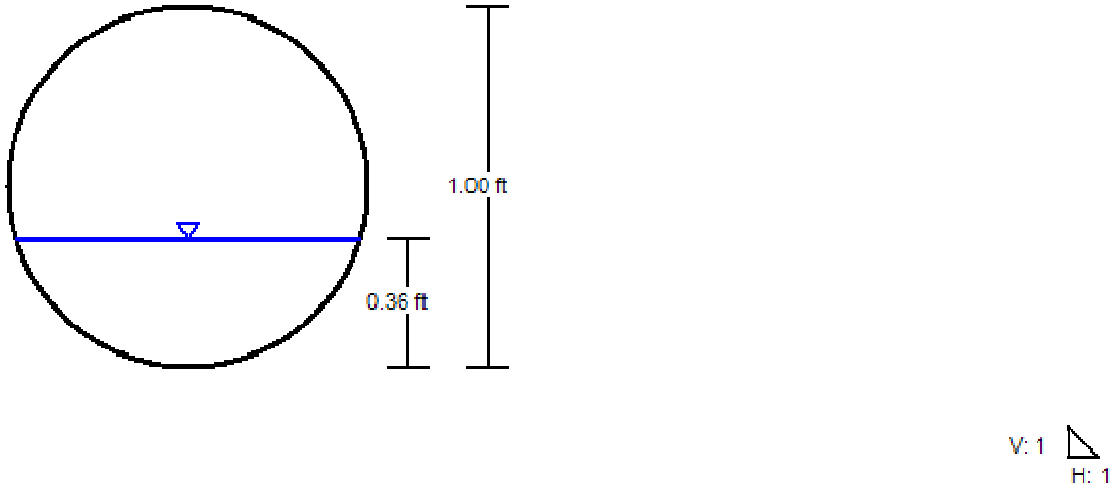
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00240 | ft/ft |
| Normal Depth | 0.36 | ft |
| Diameter | 1.00 | ft |
| Discharge | 0.47 | ft³/s |

## Cross Section Image



# AN ORDINANCE PRESCRIBING THE CONNECTION FEE RATE AND MEAN LOADINGS PER UNIT OF USAGE FOR COUNTY SANITATION DISTRICT NO. 5 OF LOS ANGELES COUNTY

**THE BOARD OF DIRECTORS OF COUNTY SANITATION DISTRICT NO. 5 OF LOS ANGELES COUNTY ORDAINS AS FOLLOWS:**

## SECTION 1.0 - USER CATEGORIES AND MEAN LOADINGS

Pursuant to Section 3.04(2) of the Master Connection Fee Ordinance of County Sanitation District No. 5 of Los Angeles County, the following shall constitute the user categories and mean loadings per unit of usage for flow, chemical oxygen demand (COD), and suspended solids:

| DESCRIPTION | UNIT OF MEASURE | FLOW (Gallons per Day) | COD (Pounds per Day) | SUSPENDED SOLIDS (Pounds per Day) |
|---|---|---|---|---|
| **RESIDENTIAL** | | | | |
| Single Family Home | Dwelling Unit | 260 | 1.22 | 0.59 |
| Condominiums | Dwelling Unit | 195 | 0.92 | 0.44 |
| Multi-Unit Residential | Dwelling Unit | 156 | 0.73 | 0.35 |
| Mobile Home Parks | No. of Spaces | 156 | 0.73 | 0.35 |
| **COMMERCIAL** | | | | |
| Hotel/Motel/Rooming House | Room | 125 | 0.54 | 0.28 |
| Store | 1000 $ft^2$ | 100 | 0.43 | 0.23 |
| Supermarket | 1000 $ft^2$ | 150 | 2.00 | 1.00 |
| Shopping Center | 1000 $ft^2$ | 325 | 3.00 | 1.17 |
| Regional Mall | 1000 $ft^2$ | 150 | 2.10 | 0.77 |
| Office Building | 1000 $ft^2$ | 200 | 0.86 | 0.45 |
| Medical, Dental, Veterinary Clinic or Building | 1000 $ft^2$ | 300 | 1.29 | 0.68 |
| Restaurant | 1000 $ft^2$ | 1,000 | 16.68 | 5.00 |
| Indoor Theatre | 1000 $ft^2$ | 125 | 0.54 | 0.28 |
| Car Wash | | | | |
| Tunnel - No Recycling | 1000 $ft^2$ | 3,700 | 15.86 | 8.33 |
| Tunnel - Recycling | 1000 $ft^2$ | 2,700 | 11.74 | 6.16 |
| Wand | 1000 $ft^2$ | 700 | 3.00 | 1.58 |
| Bank, Credit Union | 1000 $ft^2$ | 100 | 0.43 | 0.23 |
| Service Shop, Vehicle Maintenance & Repair Shop | 1000 $ft^2$ | 100 | 0.43 | 0.23 |
| Animal Kennels | 1000 $ft^2$ | 100 | 0.43 | 0.23 |
| Gas Station | 1000 $ft^2$ | 100 | 0.43 | 0.23 |
| Auto Sales | 1000 $ft^2$ | 100 | 0.43 | 0.23 |
| Wholesale Outlet | 1000 $ft^2$ | 100 | 0.43 | 0.23 |
| Nursery/Greenhouse | 1000 $ft^2$ | 25 | 0.11 | 0.06 |
| Light Manufacturing | 1000 $ft^2$ | 25 | 0.23 | 0.09 |
| Lumber Yard | 1000 $ft^2$ | 25 | 0.23 | 0.09 |
| Warehousing | 1000 $ft^2$ | 25 | 0.23 | 0.09 |
| Open Storage | 1000 $ft^2$ | 25 | 0.23 | 0.09 |
| Drive-in Theatre | 1000 $ft^2$ | 20 | 0.09 | 0.05 |

| DESCRIPTION | UNIT OF MEASURE | FLOW (Gallons per Day) | COD (Pounds per Day) | SUSPENDED SOLIDS (Pounds per Day) |
|---|---|---|---|---|
| **COMMERCIAL** | | | | |
| Night Club | 1000 $ft^2$ | 350 | 1.50 | 0.79 |
| Bowling/Skating | 1000 $ft^2$ | 150 | 1.76 | 0.55 |
| Club & Lodge Halls | 1000 $ft^2$ | 125 | 0.54 | 0.27 |
| Auditorium, Amusement | 1000 $ft^2$ | 350 | 1.50 | 0.79 |
| Golf Course and Park (Structures and Improvements) | 1000 $ft^2$ | 100 | 0.43 | 0.23 |
| Campground, Marina, and Recreational Vehicle Park | Sites, Slips, or Spaces | 55 | 0.34 | 0.14 |
| Convalescent Home | Bed | 125 | 0.54 | 0.28 |
| Laundromat | 1000 $ft^2$ | 3,825 | 16.40 | 8.61 |
| Mortuary, Funeral Home | 1000 $ft^2$ | 100 | 1.33 | 0.67 |
| Health Spa, Gymnasium | | | | |
| With Showers | 1000 $ft^2$ | 600 | 2.58 | 1.35 |
| Without Showers | 1000 $ft^2$ | 300 | 1.29 | 0.68 |
| Convention Center, Fairground, Racetrack, Sports Stadium/Arena | Average Daily Attendance | 10 | 0.04 | 0.02 |
| **INSTITUTIONAL** | | | | |
| College/University | Student | 20 | 0.09 | 0.05 |
| Private School | 1000 $ft^2$ | 200 | 0.86 | 0.45 |
| Library, Museum | 1000 $ft^2$ | 100 | 0.43 | 0.23 |
| Post Office (Local) | 1000 $ft^2$ | 100 | 0.43 | 0.23 |
| Post Office (Regional) | 1000 $ft^2$ | 25 | 0.23 | 0.09 |
| Church | 1000 $ft^2$ | 50 | 0.21 | 0.11 |

## SECTION 2.0 - CONNECTION FEE RATE

Pursuant to Section 3.03 of the Master Connection Fee Ordinance of County Sanitation District No. 5 of Los Angeles County, the following, to be effective on the dates given, shall constitute the Connection Fee Rate per capacity unit:

| July 1, 2011 | July 1, 2012 | July 1, 2013 |
|---|---|---|
| $4,350 | $4,480 | $4,610 |

## SECTION 3.0 - COST ALLOCATION FACTORS

Pursuant to Section 3.04(1) of the Master Connection Fee Ordinance of County Sanitation District No. 5 of Los Angeles County, the proportions of the total capital costs required to construct an incremental expansion of the sewerage system of the next anticipated configuration for conveyance, treatment, and disposal of wastewater which are attributable to flow, COD, and suspended solids, designated as X, Y, and Z, respectively, to be effective on the dates given, shall be:

$X = 0.6783$ $Y = 0.1222$ $Z = 0.1995$

## SECTION 4.0 - VALIDITY

If any part, section, subsection, paragraph, sentence, clause, or phrase of this Ordinance is held invalid or unconstitutional for any reason by any court, that decision does not affect the validity or constitutionality of the remainder of this Ordinance. The Board of Directors declares that it would have adopted each provision of this Ordinance irrespective of the validity of any other provision.

## SECTION 5.0 - EFFECTIVE DATE

This Ordinance shall become effective 30 days after its adoption.

ATTEST:

Kimberly A. Compton

Clerk, Board of Directors
County Sanitation District No. 5
of Los Angeles County

Chairperson, Board of Directors
County Sanitation District No. 5
of Los Angeles County

PASSED AND ADOPTED by the Board of Directors of County Sanitation District No. 5 of Los Angeles County on May 18, 2011 by the following vote:

AYES: Directors Malsin, Jacobson, Medina, Hofmann, Blackwood, Bird, Misetich, Gin, Hill, Zuckerman, Scotto, and Montgomery

NOES: Director Lambert

ABSENT: Directors Tabor, Garcetti, and Antonovich

ABSTAIN: None

Kimberly A. Compton

Secretary of the Board of Directors
County Sanitation District No. 5
of Los Angeles County

# SEWER STUDY

**Del Amo Fashion Center**

**(North of Carson Street)**

**Hawthorne Boulevard & Fashion Way**

**Torrance, CA**

Prepared For:

**SIMON Property Group**

**225 West Washington Street**

**Indianapolis, IN 46204**

Prepared By:

**Tait & Associates, Inc.**

**701 N. Parkcenter Drive**

**Santa Ana, CA 92705**

(714) 560-8200

TAIT

RISING TO THE CHALLENGE

Approved
3/25/14

August 14, 2013

**Revised December 23, 2013**

**Revised March 17, 2014**

**TAIT JOB # SP6076D**

## TABLE OF CONTENTS

## SECTION I
## INTRODUCTION/EXECUTIVE SUMMARY

The Del Amo Fashion Center is located in the City of Torrance, California, and is comprised of a large main mall building and several small outparcel buildings. The site totals 136 acres and is bounded by Fashion Way to the north, Hawthorne Boulevard to the west, Del Amo Circle East to the east (south of Carson Street), Madrona Avenue to the east (north of Carson Street) and Sepulveda Boulevard to the south. The limits of this sewer study include the portion of the mall building north of Carson Street, including the retail bridge area which traverses Carson Street, and the existing medical office building at the southeast corner of the intersection of Hawthorne Boulevard and Fashion Way.

The proposed improvements to the mall include demolition of the existing 57,775 SF (gross leaseable area (GLA)) medical office building at the southeast corner of Fashion Way and Hawthorne Boulevard, demolition of 187,797 SF (GLA) of the existing mall (consisting of 170,206 SF retail and 17,591 SF restaurant) located to the east/southeast of the medical office building, and construction of 557,975 SF (GLA) of mall expansion (consisting of 531,428 SF retail and 26,547 SF restaurant). The proposed site improvements include reconfigured parking areas to the west of the mall expansion and a new parking structure to be located to the east of the proposed mall expansion.

The total acreage to be developed is approximately 27 acres. The total area (GLA) of the existing mall building under consideration is 928,242 SF. Remaining portions of the mall building not included in the scope (and their associated sewer flows) are unaffected and unchanged by the proposed improvements.

The existing mall building north of Carson Street is served by two (2) different City sewer lines which ultimately convey sewage into two (2) County Sanitation Districts of Los Angeles County (LACSD) sewers. The existing medical office building and 328,977 SF (GLA) of the existing mall north of Carson Street is served by 12" VCP City sewer within Hawthorne Boulevard, which flows to the south and directly discharges to the LACSD South Torrance Trunk Sewer (15" VCP) at the intersection of Hawthorne Boulevard and Sepulveda Boulevard. A total of 599,265 SF (GLA) of the existing mall north of Carson Street is served by the 10" VCP private sewer within Fashion Way, which flows to the east, then south along Madrona Avenue. Downstream of the Fashion Way/Madrona Avenue private sewer is the 10" VCP City sewer within El Dorado Street; further downstream is the 15" VCP City Sewer within Maple Avenue; the City sewer ultimately discharges to the LACSD Maricopa Street Trunk Sewer (18" VCP) at the intersection of Maple Avenue and Maricopa Street.

Figure 1, "Existing Sewer Exhibit" in Appendix A depicts the portions of the mall served by each sewer. City of Torrance Sanitary Sewer Atlas Sheets 55, 62, and 69, depicting the Hawthorne Boulevard sewer, and Sheets 55 and 56, depicting the Fashion Way/Madrona Avenue/El Dorado Street/Maple Avenue Sewer, are also provided in Appendix A.

Temporary flow monitoring was conducted to determine the peak flow for the existing sewers within Hawthorne Boulevard and El Dorado Street. Three (3) manhole locations of the sewer

flow monitoring within Hawthorne Boulevard were coordinated with the City of Torrance, and ADS Environmental Services was contracted to perform the temporary flow monitoring. In-line flows within two (2) manholes in Hawthorne Boulevard were monitored, and the third location monitored the entering (westward) flow from within the 10" sewer that crosses Hawthorne Boulevard. The flows at the manholes were monitored for a total of 14 continuous days from May 18, 2013, through May 31, 2013, with the monitoring devices recording flows in 5-minute intervals. One (1) location within El Dorado Street was monitored by ADS Environmental Services. The entering (eastward) flow from the 10" sewer within El Dorado Street at its manhole intersection with the Maple Avenue sewer was monitored for a total of 14 continuous days from October 16, 2013, through October 29, 2013, with the monitoring devices recording flows in 5 minute intervals.

The monitoring studies and complete printout of the data is provided in Appendix B. Locations of the Temporary Flow Monitoring Study are provided on City of Torrance Sanitary Sewer Atlas Sheets 62 and 69 (for Hawthorne Boulevard) and Sheets 55 and 56 (for El Dorado Street) in Appendix A.

A previously submitted sewer study for the Del Amo Fashion Center, prepared by Sikand Engineering Associates, dated April 15, 2005, was utilized for calculating the existing peak flow for the existing sewers within Fashion Way / El Dorado Street / Maple Avenue.

## SECTION II
## SEWER DEMAND OF PROJECT

The proposed mall expansion will result in construction of a gross total of approximately 557,975 SF of gross leasable area. Of the total area to be constructed, 271,690 SF of retail and 26,547 SF of restaurant will be served by the Hawthorne Boulevard City sewer, while 259,738 SF of the new portion will be served by the Fashion Way private sewer.

Figure 2, "Proposed Sewer Exhibit," in Appendix B depicts the proposed portions of the mall under consideration to be served by each sewer.

While taking into account these new anticipated flows and simultaneously taking a credit for the demolition of 57,775 SF of medical office and 187,797 SF of existing mall, there is a net increase of 13,332 gpd in the Hawthorne Boulevard sewer and 14,414 gpd in the Fashion Way sewer.

The existing and proposed site contributions to the above referenced public sewers were determined using the building size, use type and County of Los Angeles Loading Table for the buildings. The proposed additional average sewer flows to the public sewers were converted from gallons per day (gpd) to cubic feet per second (cfs). The peak flows for these proposed additional average sewer flows were obtained from the formula 2.65 * [(Average Flow)^0.906].

The measured peak results from the Temporary Flow Monitoring Study and the proposed additional peak sewer flows were then input into the Manning Pipe Calculator in LandDesktop 2009 computer program to analyze the effects on the sewer capacity. To provide a conservative approach, depths were calculated from the measured maximum flows in the Temporary Flow Monitoring Study and compared to the measured maximum depth, with the larger value of depth (measured or calculated, with associated flow) being used in the calculations. This resulted in higher percentage full values used as the existing condition for the public sewer mains. The additional peak flows were then added to these measured peaks and the percent full and flow depth was calculated for analysis of their impacts.

## SECTION III
## FLOW IN PUBLIC SYSTEM

### Hawthorne Boulevard Sewer

The existing flows from the Temporary Flow Monitoring Study are provided below:

| Flow Monitoring Study Designation | Location | Pipe Diameter (Inches) | Slope (%) | Measured Maximum Flow (MGD) | Measured Maximum Flow (cfs) | Measured Maximum Depth (inches) | Calculated Maximum Depth from Maximum Flow (inches) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|---|
| CARS04 | Carson/Hawthorne Intersection (measuring westward flow) | 10 | 0.44 | 0.196 | 0.3033 | 3.62 | 3.10 | 2.29 | 36.34 |
| HAWT01 | South of Carson/Hawthorne Intersection (measuring southward flow) | 12 | 0.24 | 0.442 | 0.6839 | 5.04 | 5.22 | 2.09 | 43.48 |
| HAWT03 | North of Sepulveda/Hawthorne Intersection (measuring southward flow) | 12 | 0.24 | 0.424 | 0.6561 | 4.90 | 5.10 | 2.06 | 42.48 |

Notes:

1. Slopes for the pipes were obtained from the plan titled "Del Amo – Hawthorne Ave – Sanitary Sewer Line" (Plan No. SS-142), dated 05-27-59.
2. Percent Full is from the larger of the Measured or Calculated Depth. For the CARS04 location, a flowrate of 0.41 cfs was calculated for the measured depth of 3.62 inches, and was used as the base peak flow for the proposed condition.
3. Note that although the measured peak flow at HAWT01 (upstream) is slightly higher than HAWT03 (downstream), it is considered minimal because the differences between the two measurements is slight and the average flow values between the two measured stations are consistent with the upstream/downstream relationship.

Ave Flow for HAWT01 = .214 MGD ; Ave Flow for HAWT03 = .231 MGD

The sewer pipes under consideration are 12" and smaller, and typically designed to run at 50% of capacity. The pipes in the three locations under existing conditions are all flowing below 50% capacity.

The following table compares the 2013 measured flows with the flows contained in the "1992 Torrance Sewer Master Plan":

| Flow Monitoring Study Designation | Location | 2013 Measured Maximum Depth (inches) | Percent Full (%) | Torrance Manhole Node | 1992 Torrance Sewer Master Plan Depth (inches) | Percent Full (%) |
|---|---|---|---|---|---|---|
| CARS04 | Carson/Hawthorne Intersection (measuring westward flow) | 3.62 | 36.34 | 62-2-04 | 1.9 | 8 |
| HAWT01 | South of Carson/Hawthorne Intersection (measuring southward flow) | 5.04 | 43.48 | 62-5-01 | 3.8 | 22 |
| HAWT03 | North of Sepulveda/Hawthorne Intersection (measuring southward flow) | 4.90 | 42.48 | 69-2-03 | 5.5 | 43 |

The most downstream (HAWT03) location is consistent with the 1992 Sewer Master Plan; the other two locations measured more full than the 1992 Sewer Master Plan. This could be a result of several factors, including different land uses and associated occupancy rates 20+ years ago as compared to the 2013 dates.

The proposed additional flow for the improvements was obtained by calculating the flow from the proposed building portion and reducing it by a credit for the existing building portion to be demolished. The proposed improvements were calculated to add 0.079 cfs peak flow.

The flows under proposed conditions are summarized below:

| Flow Monitoring Study Designation | Location | Pipe Diameter (Inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (Base Peak Plus Additional Peak) (cfs) | Calculated Maximum Depth from Proposed Peak Flow (inches) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|
| CARS04 | Carson/Hawthorne Intersection (measuring westward flow) | 10 | 0.44 | 0.4100 | 0.4890 | 4.00 | 2.40 | 39.97 |
| HAWT01 | South of Carson/Hawthorne Intersection (measuring southward flow) | 12 | 0.24 | 0.6839 | 0.7629 | 5.55 | 2.15 | 46.25 |
| HAWT03 | North of Sepulveda/Hawthorne Intersection (measuring southward flow) | 12 | 0.24 | 0.6561 | 0.7351 | 5.43 | 2.13 | 45.28 |

The proposed flow increases the capacity to less than 50% for all three locations: therefore it does not warrant an increase in pipe size.

**Fashion Way / Madrona Avenue / El Dorado Street / Maple Avenue Sewer**

The Sikand sewer study, prepared in 2005, provided calculations for the entire northern portion of the mall (north of Carson Street, including the retail bridge north of Macy's B) based upon a GLA of 1,377,339 SF, which calculated to a peak demand of 0.62 cfs. In reality, the full build-out of this condition never occurred and the total GLA that is presently contained in the mall north of Macy's B is 928,242 SF. This is nearly 450,000 SF less of contributing area than the Sikand study presents.

In addition, the Sikand study conservatively routed all existing sewer flows generated by the mall north of Carson Street to the Fashion Way/Madrona Avenue sewer. In reality, there is also another on-site sewer which runs along the western side of the existing mall (west of Macy's C) and connects to the Hawthorne Boulevard sewer at the northeast corner of the Hawthorne Boulevard/Carson Street intersection (see Figure 1 in Appendix A). There is 328,977 SF of GLA (comprised of 77,085 SF to be demolished, plus 251,892 SF Macy's C to remain) currently being served by the Hawthorne Boulevard sewer.

As a result of these two items, the existing flow to Fashion Way and associated downstream sewers is less than what is presented in the Sikand study.

The following table and calculations summarize the proposed sewer flows calculated in the Sikand report based upon the proposed condition as understood in 2005, the associated reduction from what is presently on-site, and the calculated flow that was subsequently used as the "existing" flow for the calculations.

Accordingly, the following calculations present the current demand on the Fashion Way sewer from the existing mall:

928,242 SF – (251,892 SF + 77,085 SF) = 599,265 SF currently contributing to Fashion Way / Madrona Avenue sewer

599,265 SF * [100 gpd / 1000 SF] * [1 cfs / 646,320 gpd] = 0.0927 cfs average flow

2.65 * [(0.0927)^0.906] = 0.307 cfs current peak demand

The following table summarizes the Base Peak Flows used for the calculations:

Nice discussion, but ss in El Dorado is currently flowing (peak) @ ½ full (see next page). The mall expansion (proposed) will add 14,414 GPD to this sewer (see page 4). El Dorado ss needs to be upsized.

| Street | Sikand Sewer Study 2004 Measured Peak Flow (cfs) | 2013 Base Peak Flow (cfs) |
|---|---|---|
| Fashion Way | 0.10 | 0.42 (see note 1) |
| El Dorado Street | 0.54 | 0.55 (see note 2) |
| Maple Avenue | 0.90 | 0.91 (see note 3) |

Notes:

1. Sikand Study Measured Flow plus Current Peak Demand outlined above. This is due to the fact the mall sewer flows in 2004 traveled across mall property directly to sewer main in Madrona Avenue. After Fashion Way sewer was constructed in 2006 or so, these flows went to the newly constructed Fashion Way sewer line. Adjusted by 0.01 cfs to adjust for difference between Sikand Study 2004 Measured Flow and October 2013 Temporary Flow Monitoring for El Dorado Street sewer. (0.10 + 0.307 + 0.01 = 0.42 cfs)
2. Measured via October 2013 Temporary Flow Monitoring; correlates closely to Sikand Study 2004 Measured Flow
3. Adjusted by 0.01 cfs to adjust for difference between Sikand Study 2004 Measured Flow and October 2013 Temporary Flow Monitoring for El Dorado Street sewer.

Temporary flow monitoring was performed at the intersection of the El Dorado Street sewer/Maple Avenue sewer intersection, measuring the entering eastward flow from the El Dorado Street sewer. The existing flow information is provided below:

| Flow Monitoring Study Designation | Location | Pipe Diameter (Inches) | Slope (%) | Measured Maximum Flow (MGD) | Measured Maximum Flow (cfs) | Measured Maximum Depth (inches) | Calculated Maximum Depth from Maximum Flow (inches) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|---|
| ELD_01A | El Dorado/Maple Intersection (measuring eastward flow) | 10 | 0.24 | 0.356 | 0.5509 | 4.80 | 5.08 | 1.98 | 50.78 |

Notes:

1. Slopes for the pipes were obtained from the plan titled "Plan and Profile Proposed Sanitary Sewer Line along Maple Avenue, El Dorado Street, and CCMO Private Street" (Plan No. SM-1-1), last revised 03-12-51.
2. Percent Full is from the larger of the Measured or Calculated Depth.

The associated flow depths under existing conditions are summarized below:

| Street | Diameter (inches) | Slope (%) | Existing Peak Flow (cfs) | Depth (in) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|
| Fashion Way | 10 | 0.36 | 0.42 | 3.89 | 2.14 | 38.85 |
| El Dorado Street | 10 | 0.24 | 0.55 | 5.08 | 1.98 | 50.78 |
| Maple Avenue | 15 | 0.20 | 0.91 | 5.78 | 2.09 | 38.56 |

The Fashion Way and El Dorado Sewers are less than 12 inches and therefore are typically designed to run at 50% of capacity. The Maple Avenue Sewer is 15 inches and typically

designed to run at 75% of capacity. Under existing conditions, the Fashion Way sewer is flowing below 50% capacity, El Dorado Street sewer is flowing slightly above 50% capacity, and Maple Avenue is flowing below 75% capacity.

The following table compares the 2013 measured flows with the flows contained in the "1992 Torrance Sewer Master Plan":

| Street | Existing Depth (inches) meas peak | Percent Full (%) | Torrance Manhole Node | 1992 Torrance Sewer Master Plan Depth (inches) | Percent Full (%) |
|---|---|---|---|---|---|
| Fashion Way | 3.89 | 38.85 | 56-4-02 | See Note 1 | N/A |
| El Dorado Street | 5.08 | 50.78 | 56-5-14 | 6.7 | 79 |
| Maple Avenue | 5.78 | 38.56 | 56-2-03 | 7.2 | 46 |

Notes:

1. Sewer manhole nodes from the current City sewer atlas sheets are inconsistent with sewer nodes presented in the 1992 Torrance Sewer Master Plan.

The El Dorado Street sewer's 2013 measured depth (as well as the Sikand 2004 measured depth) is significantly lower than the 1992 Sewer Master Plan. The Maple Avenue existing depth (based on the Sikand 2004 measured depth) is also lower than the 1992 Sewer Master Plan. This could be a result of several factors, including different land uses and associated occupancy rates 20+ years ago as compared to the present. Since the 2013 measured flow in El Dorado Street correlates closely to the 2004 Sikand measured flow as discussed above, the changes in impact to the City sewer system appear to occur before 2004.

The proposed additional flow for the improvements was obtained by subtracting the calculated flows from existing building portion from the calculated flow of the proposed building portion. The proposed improvements were calculated to add 0.085 cfs peak flow.

The associated flow depths under proposed conditions are summarized below:

| Street | Diameter (inches) | Slope (%) | Proposed Peak Flow (cfs) | Depth (in) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|
| Fashion Way | 10 | 0.36 | 0.505 | 4.30 | 2.25 | 43.00 |
| El Dorado Street | 10 | 0.24 | 0.635 | 5.53 | 2.05 | 55.34 |
| Maple Avenue | 15 | 0.20 | 0.995 | 6.07 | 2.14 | 40.48 |

The proposed flow further increases the pipe capacity for El Dorado Street above 50%. Accordingly, the El Dorado Street sewer is recommended to be increased from a 10" to a 12" sewer. As a result of the proposed increase in size, the associated flow depth would be as follows:

| Street | Proposed Diameter (inches) | Slope (%) | Proposed Peak Flow (cfs) | Depth (in) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|
| El Dorado Street | 12 | 0.24 | 0.635 | 5.01 | 2.05 | 41.72 |

The replacement of the 10" sewer within El Dorado Street to a 12" sewer is anticipated to lower the percent full to below 50%.

Currently, the City has indicated that there have been preliminary discussions with the owner/developer (not Simon Property Group) about developing the parcel immediately to the east of the mall (Madrona parcel). If the El Dorado Street sewer was replaced with a 15" sewer instead of a 12" sewer (in anticipation of the future development), the associated flow depth would be as follows:

| Street | Proposed Diameter (inches) | Slope (%) | Proposed Peak Flow (cfs) | Depth (in) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|
| El Dorado Street | 15 | 0.24 | 0.635 | 4.58 | 2.02 | 30.38 |

**Only accounts for mall redevelopment flows, not future Madrona parcel development flows.

Cost-sharing between Simon Property Group and the Madrona parcel developer should be investigated to split the cost of improving the El Dorado Street sewer. However, a complete sewer study by the Madrona parcel developer would be necessary in the future to determine its complete impacts on the City sewer system.

Based on our analysis, upon completion of the proposed improvements to the El Dorado Street sewer, there is sufficient capacity available for the anticipated flow increases of the proposed project.

# SECTION IV
# CALCULATIONS

## Existing Flows from Site to Hawthorne Boulevard

| Building | Use/Type | Unit | Average Daily Flow (gpd/unit) | Total Daily Flow (gpd) |
|---|---|---|---|---|
| Medical Office | Medical Buildings | 57,775 SF | 300 /1000 Gross SF | 17,333 |
| Mall Retail | Commercial Shops & Stores | 60,037 SF | 100 /1000 Gross SF | 6,004 |
| Mall Restaurant | Restaurant | 17,048 SF | 1000 /1000 Gross SF | 17,048 |
| | | | **Total** | **40,384** |

## Proposed Flows from Site to Hawthorne Boulevard

| Building | Use/Type | Unit | Average Daily Flow (gpd/unit) | Total Daily Flow (gpd) |
|---|---|---|---|---|
| Mall Retail | Commercial Shops & Stores | 271,690 SF | 100 /1000 Gross SF | 27,169 |
| Mall Restaurant | Restaurant | 26,547 SF | 1000 /1000 Gross SF | 26,547 |
| | | | **Total** | **53,716** $= .083$ cfs |

Peak flow $= 2.65(.083^{.906}) = .28$ cfs

= peak flows in proposed west sewer SS-3134

53,716 − 40,384 = 13,332 gpd with 2 hrs to drain (Manning)

measured = .021 cfs

peak = 2.65(.021)$^{.906}$ = .079 cfs peak with

## Existing Flows from Site to Fashion Way

| Building | Use/Type | Unit | Average Daily Flow (gpd/unit) | Total Daily Flow (gpd) |
|---|---|---|---|---|
| Mall Retail | Commercial Shops & Stores | 110,169 SF | 100 /1000 Gross SF | 11,017 |
| Mall Restaurant | Restaurant | 543 SF | 1000 /1000 Gross SF | 543 |

Note: Existing Restaurant spaces outside of the limit of the proposed improvements are unchanged between existing and proposed conditions and are therefore not included in the calculations.

**Total** **11,560**

## Proposed Flows from Site to Fashion Way

| Building | Use/Type | Unit | Average Daily Flow (gpd/unit) | Total Daily Flow (gpd) |
|---|---|---|---|---|
| Mall Retail - Sewer South of Mall | Commercial Shops & Stores | 127,039 SF | 100 /1000 Gross SF | 12,704 |
| Mall Retail - Sewer North of Mall | Commercial Shops & Stores | 132,699 SF | 100 /1000 Gross SF | 13,270 |

**Total** **25,974**

## Hawthorne Boulevard Added Sewer Flow

| Building | Total Daily Flow (gpd) | Average Flow (cfs) | Peak Flow (cfs) 2.65*[(Avg Flow)^0.906] |
|---|---|---|---|
| Proposed Minus Existing Flows | 13,332 | 0.021 | 0.079 |

## Fashion Way Added Sewer Flow

| Building | Total Daily Flow (gpd) | Average Flow (cfs) | Peak Flow (cfs) 2.65*[(Avg Flow)^0.906] |
|---|---|---|---|
| Proposed Minus Existing Flows | 14,414 | 0.022 | 0.085 |

TAIT
RISING TO THE CHALLENGE

Addendum #1

September 10, 2014

Mr. Ted Symons
City of Torrance
3031 Torrance Blvd.
Torrance, CA 90503

Re: Del Amo Fashion Center – Sewer Study Addendum

Ted Symons
9/25/14

Dear Mr. Symons:

This letter is to serve as an Addendum to the previously submitted Sewer Study prepared by our office, last revised March, 17, 2014. The potential has been discussed for two (2) future restaurant pads to be constructed on the west side of the proposed mall expansion (see updated Figure 2, which is revised from the Figure 2 previously provided in the March sewer study).

The additional square footages from this revised site plan will result in an increase of 15,300 square feet of restaurant use. The restaurant square footage contributing to the Hawthorne Boulevard sewer in the March sewer study was 26,547 square feet; adding the new restaurant area to the previously proposed restaurant area results in 41,847 square feet, with all other areas remaining unchanged.

The proposed additional flow for the improvements was obtained by calculating the flow from the proposed building portion and reducing it by a credit for the existing building portion to be demolished. The proposed improvements were calculated to add 0.157 cfs peak flow.

The total flows under these alternate proposed conditions are summarized below:

| Flow Monitoring Study Designation | Location | Pipe Diameter (Inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (Base Peak Plus Additional Peak) (cfs) | Calculated Maximum Depth from Proposed Peak Flow (inches) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|
| CARS04 | Carson/Hawthorne Intersection (measuring westward flow) | 10 | 0.44 | 0.4100 | 0.5670 | 4.34 | 2.50 | 43.37 |
| HAWT01 | South of Carson/Hawthorne Intersection (measuring southward flow) | 12 | 0.24 | 0.6839 | 0.8409 | 5.87 | 2.20 | 48.92 |
| HAWT03 | North of Sepulveda/Hawthorne Intersection (measuring southward flow) | 12 | 0.24 | 0.6561 | 0.8131 | 5.76 | 2.18 | 47.97 |

Similar to the original proposed condition, the proposed flow for this alternate proposed condition still increases the capacity to less than 50% for all three locations; therefore it does not warrant an increase in pipe size.

We trust that the enclosed information is sufficient for your review and approval. Please let us know if you need any additional information.

Thank you for your continued assistance on this project.

Sincerely,
TAIT & ASSOCIATES, INC.

MICHAEL P. SILVEY, PE
Vice President

TAIT
RISING TO THE CHALLENGE

701 N. Parkcenter Drive, Santa Ana, CA 92705

p: 714.560.8200 www.tait.com

Addendum #1

September 09, 2015

Approved
T. Symons
9/15/15

Mr. Ted Symons
City of Torrance
3031 Torrance Blvd.
Torrance, CA 90503

Re: Del Amo Fashion Center – Sewer Study Addendum

Dear Mr. Symons:

This letter is to serve as an Addendum to the previously submitted Sewer Study prepared by our office, last revised March, 17, 2014. The potential has been discussed for the Nordstrom building and Great Maple restaurant sewer to be routed, at a future date, to a pump station on the north side of the parking lot, where the sewer would be fed via gravity flow eastward along Fashion Way and connect to the existing Fashion Way sewer.

The square footages for this contributing area are outlined below:

**Proposed Additional Flows to Fashion Way**

| Building | Use/Type | Unit | Average Daily Flow (gpd/unit) | Total Daily Flow (gpd) |
|---|---|---|---|---|
| Mall Retail | Commercial Shops & Stores | 138,000 SF | 100 /1000 Gross SF | 13,800 |
| Mall Restaurant | Restaurant | 8,085 SF | 1000 /1000 Gross SF | 8,085 |
| | | | **Total** | **21,885** |

**Fashion Way Added Sewer Flow**

| Building | Total Daily Flow (gpd) | Average Flow (cfs) | Peak Flow (cfs) 2.65*[(Avg Flow)^0.906] |
|---|---|---|---|
| Additional Flows | 21,885 | 0.034 | 0.123 |

The proposed diversion sewer is calculated to add 0.123 cfs peak flow. Please refer to the updated Figure 2 depicting the building square footages which would contribute to this sewer diversion.

As part of the proposed mall development, a new sewer line (15" VCP at 0.33% slope per sewer plan SS-390) is to be constructed within Madrona Avenue and Opal Street. This line will pick up all of the flows from Fashion Way, which will now be routed to the north on Madrona Avenue, then east on Opal Street to a newly constructed manhole within Maple Avenue. Previously, these flows were routed south on Madrona Avenue, then east on El Dorado Street, to a manhole within Maple Avenue.

The peak flow under originally proposed conditions in the Fashion Way sewer is 0.505 cfs per the March 17, 2014, sewer study. This entire flow will be routed through the newly constructed

Madrona/Opal sewer, and will be the "existing" flow in this sewer line once this sewer is operational. (Scenario 1)

There also is the potential for a future development to be constructed immediately east of the mall, between the mall property and Madrona Avenue (Madrona parcel). The City of Torrance has indicated that such a development could add up to 0.56 cfs peak flow based on current zoning. This flow would enter at the newly constructed manhole at the intersection of Fashion Way and Madrona Avenue. (Scenario 2)

The existing single family residences on the north side of Opal Street could also tie into the Opal Street sewer at a future date. There are a total of 25 residences which could contribute sewer flows to this sewer line. (Scenario 3)

**Proposed Additional Flows to Opal Street**

| Building | Use/Type | Unit | Average Daily Flow (gpd/unit) | Total Daily Flow (gpd) |
|---|---|---|---|---|
| Residences (Single Family) (North Side of Street) | Single Family | 25 ea | 260 /unit | 6,500 |
| | | | **Total** | **6,500** |

**Opal Street Residences (North Side) Added Sewer Flow**

| Building | Total Daily Flow (gpd) | Average Flow (cfs) | Peak Flow (cfs) 2.65*[(Avg Flow)^0.906] |
|---|---|---|---|
| Additional Flows | 6,500 | 0.010 | 0.041 |

The future potential connections from all of the Opal Street residences on the north side of the street are calculated to add 0.041 cfs peak flow.

These three different "base" scenarios for Madrona/Opal are summarized below:

| Scenario | Street | Diameter (inches) | Slope (%) | Peak Flow (cfs) | Depth (in) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|
| 1 | Madrona Avenue/Opal Street (Fashion Way peak flows only) | 15 | 0.33 | 0.505 | 3.74 | 2.11 | 24.92 |
| 2 | Madrona Avenue/Opal Street (Scenario 1 + Madrona Parcel Peak Flow) | 15 | 0.33 | 1.065 | 5.50 | 2.61 | 36.67 |
| 3 | Madrona Avenue/Opal Street (Scenario 2 + Opal Residences Peak Flow) | 15 | 0.33 | 1.106 | 5.61 | 2.64 | 37.42 |

"additional peak"

Taking into account the mall sewer diversion flows (0.123 cfs), the total flows under the mall sewer diversion condition are summarized below.

| Scenario | Street | Diameter (inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (Base Peak Plus Additional Peak) (cfs) | Depth (in) | Velocity (ft/sec) | Percent Full (%) |
|---|---|---|---|---|---|---|---|---|
| -- | Fashion Way | 10 | 0.36 | 0.505 | 0.628 | 4.87 | 2.38 | 48.68 |
| 1 | Madrona/Opal (Fashion Way peak flows only) | 15 | 0.33 | 0.505 | 0.628 | 4.17 | 2.25 | 27.83 |
| 2 | Madrona/Opal (Scenario 1 + Madrona Parcel Peak Flow) | 15 | 0.33 | 1.065 | 1.188 | 5.84 | 2.69 | 38.90 |
| 3 | Madrona /Opal (Scenario 2 + Opal Residences Peak Flow) | 15 | 0.33 | 1.106 | 1.229 | 5.94 | 2.72 | 39.62 |

The proposed flow for this condition still increases the capacity to less than 50%; therefore it does not warrant an increase in pipe size.

We trust that the enclosed information is sufficient for your review and approval. Please let us know if you need any additional information.

Thank you for your continued assistance on this project.

Sincerely,
TAIT & ASSOCIATES, INC.

REGISTERED PROFESSIONAL ENGINEER
MICHAEL P. SILVEY
No.CO58651
Exp.12/31/2016
CIVIL
STATE OF CALIFORNIA

MICHAEL P. SILVEY, PE
Vice President

Available capacity in 15" RCP in Maple is limiting factor for future flows from "Madrona parcel"

# Worksheet for Prop. Condition Hawthorne 12" Sewer (No Delayed Discharge of Office Bldg)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00240 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 1.02 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.55 | ft |
| Flow Area | 0.44 | $ft^2$ |
| Wetted Perimeter | 1.67 | ft |
| Hydraulic Radius | 0.26 | ft |
| Top Width | 1.00 | ft |
| Critical Depth | 0.42 | ft |
| Percent Full | 54.8 | % |
| Critical Slope | 0.00582 | ft/ft |
| Velocity | 2.31 | ft/s |
| Velocity Head | 0.08 | ft |
| Specific Energy | 0.63 | ft |
| Froude Number | 0.61 | |
| Maximum Discharge | 1.88 | $ft^3/s$ |
| Discharge Full | 1.75 | $ft^3/s$ |
| Slope Full | 0.00081 | ft/ft |
| Flow Type | SubCritical | |

# Worksheet for Prop. Condition Hawthorne 12" Sewer (No Delayed Discharge of Office Bldg)

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 54.77 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.55 | ft |
| Critical Depth | 0.42 | ft |
| Channel Slope | 0.00240 | ft/ft |
| Critical Slope | 0.00582 | ft/ft |

# Cross Section for Prop. Condition Hawthorne 12" Sewer (No Delayed Discharge of Office Bldg)

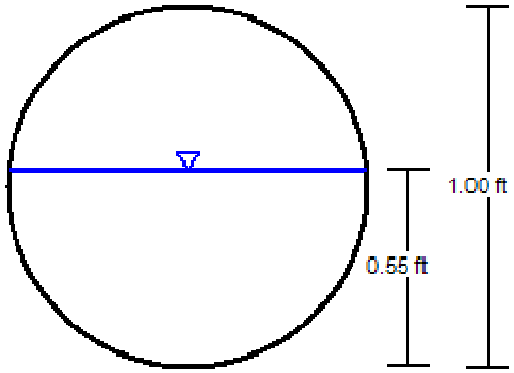
## Project Description

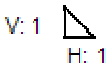
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00240 | ft/ft |
| Normal Depth | 0.55 | ft |
| Diameter | 1.00 | ft |
| Discharge | 1.02 | ft³/s |

## Cross Section Image



## SCENARIO 1: NO DELAYED DISCHARGE OF 12-STORY OFFICE BUILDING

| Building | Use/Type | Unit | Average Daily Flow | Total Daily Flow |
|---|---|---|---|---|
| | | | (gpd/unit) [1] | (gpd) |
| 12-Story Office | Commercial Office Space | 0 | 0.2 | 0 |
| Exist. Restaurant | Restaurant | -8,244 | 1 | -8,244 |
| Prop. Restaurant | Restaurant | 12,031 | 1 | 12,031 |
| Prop. Fitness Center | Health Spa, Gymnasium (with showers) | 47,227 | 0.6 | 28,336 |
| | | | Net Total | 32,123 |
| | | | Average Flow | 0.04970 |
| | | | Peak Flow | 0.1746 |

| Flow Monitor Station | Location | Pipe Diameter (inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (cfs) | Calculated Max Depth from Prop. Peak Flow (inches) | Velocity (ft/sec) | Percent Full |
|---|---|---|---|---|---|---|---|---|
| HAWT01 | Hawthorne and Carson | 12 | 0.24 | 0.8409 | 1.0155 | 6.6 | 2.31 | 54.8 |
| | | | | | | *Determined from FlowMaster | | |

# Worksheet for Prop. Condition Hawthorne 12" Sewer (Delayed Discharge of 1/2 Office Bldg)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00240 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 0.91 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.51 | ft |
| Flow Area | 0.41 | $ft^2$ |
| Wetted Perimeter | 1.60 | ft |
| Hydraulic Radius | 0.25 | ft |
| Top Width | 1.00 | ft |
| Critical Depth | 0.40 | ft |
| Percent Full | 51.3 | % |
| Critical Slope | 0.00575 | ft/ft |
| Velocity | 2.25 | ft/s |
| Velocity Head | 0.08 | ft |
| Specific Energy | 0.59 | ft |
| Froude Number | 0.62 | |
| Maximum Discharge | 1.88 | $ft^3/s$ |
| Discharge Full | 1.75 | $ft^3/s$ |
| Slope Full | 0.00065 | ft/ft |
| Flow Type | SubCritical | |

# Worksheet for Prop. Condition Hawthorne 12" Sewer (Delayed Discharge of 1/2 Office Bldg)

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 51.25 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.51 | ft |
| Critical Depth | 0.40 | ft |
| Channel Slope | 0.00240 | ft/ft |
| Critical Slope | 0.00575 | ft/ft |

# Cross Section for Prop. Condition Hawthorne 12" Sewer (Delayed Discharge of 1/2 Office Bldg)

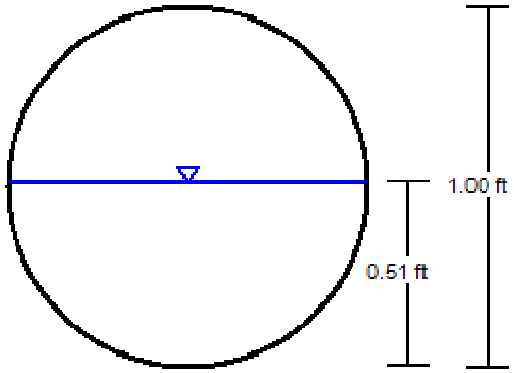
## Project Description

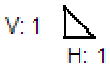
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00240 | ft/ft |
| Normal Depth | 0.51 | ft |
| Diameter | 1.00 | ft |
| Discharge | 0.91 | ft³/s |

## Cross Section Image



## SCENARIO 2: HALF DELAYED DISCHARGE OF 12-STORY OFFICE BUILDING

| Building | Use/Type | Unit | Average Daily Flow | Total Daily Flow |
|---|---|---|---|---|
| | | | (gpd/unit) [1] | (gpd) |
| 12-Story Office | Commercial Office Space | -100,000 | 0.2 | -20,000 |
| Exist. Restaurant | Restaurant | -8,244 | 1 | -8,244 |
| Prop. Restaurant | Restaurant | 12,031 | 1 | 12,031 |
| Prop. Fitness Center | Health Spa, Gymnasium (with showers) | 47,227 | 0.6 | 28,336 |
| | | | Net Total | 12,123 |
| | | | Average Flow | 0.01876 |
| | | | Peak Flow | 0.0722 |

| Flow Monitor Station | Location | Pipe Diameter (inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (cfs) | Calculated Max Depth from Prop. Peak Flow (inches) | Velocity (ft/sec) | Percent Full |
|---|---|---|---|---|---|---|---|---|
| HAWT01 | Hawthorne and Carson | 12 | 0.24 | 0.8409 | 0.9131 | 6.12 | 2.25 | 51.3 |
| | | | | | | *Determined from FlowMaster | | |

# Worksheet for Prop. Condition Hawthorne 12" Sewer (Delayed Discharge of Whole Office Bldg)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00240 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 0.79 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.47 | ft |
| Flow Area | 0.36 | $ft^2$ |
| Wetted Perimeter | 1.51 | ft |
| Hydraulic Radius | 0.24 | ft |
| Top Width | 1.00 | ft |
| Critical Depth | 0.37 | ft |
| Percent Full | 47.2 | % |
| Critical Slope | 0.00569 | ft/ft |
| Velocity | 2.17 | ft/s |
| Velocity Head | 0.07 | ft |
| Specific Energy | 0.54 | ft |
| Froude Number | 0.63 | |
| Maximum Discharge | 1.88 | $ft^3/s$ |
| Discharge Full | 1.75 | $ft^3/s$ |
| Slope Full | 0.00049 | ft/ft |
| Flow Type | SubCritical | |

# Worksheet for Prop. Condition Hawthorne 12" Sewer (Delayed Discharge of Whole Office Bldg)

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 47.18 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.47 | ft |
| Critical Depth | 0.37 | ft |
| Channel Slope | 0.00240 | ft/ft |
| Critical Slope | 0.00569 | ft/ft |

# Cross Section for Prop. Condition Hawthorne 12" Sewer (Delayed Discharge of Whole Office Bldg)

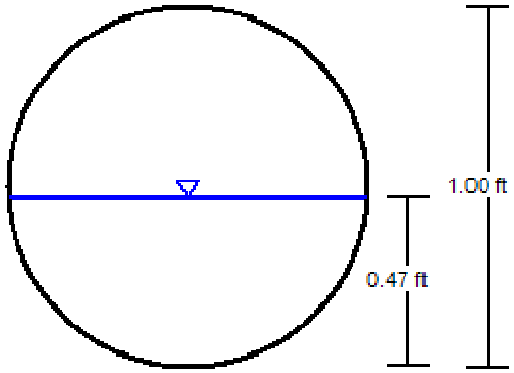
## Project Description

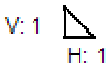
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00240 | ft/ft |
| Normal Depth | 0.47 | ft |
| Diameter | 1.00 | ft |
| Discharge | 0.79 | ft³/s |

## Cross Section Image



## SCENARIO 3: FULL DELAYED DISCHARGE OF 12-STORY OFFICE BUILDING

| Building | Use/Type | Unit | Average Daily Flow | Total Daily Flow |
|---|---|---|---|---|
| | | | (gpd/unit) [1] | (gpd) |
| 12-Story Office | Commercial Office Space | -200,000 | 0.2 | -40,000 |
| Exist. Restaurant | Restaurant | -8,244 | 1 | -8,244 |
| Prop. Restaurant | Restaurant | 12,031 | 1 | 12,031 |
| Prop. Fitness Center | Health Spa, Gymnasium (with showers) | 47,227 | 0.6 | 28,336 |
| | | | Net Total | -7,877 |
| | | | Average Flow | -0.01219 |
| | | | Peak Flow | -0.0489 |

| Flow Monitor Station | Location | Pipe Diameter (inches) | Slope (%) | Base Peak Flow (cfs) | Proposed Peak Flow (cfs) | Calculated Max Depth from Prop. Peak Flow (inches) | Velocity (ft/sec) | Percent Full |
|---|---|---|---|---|---|---|---|---|
| HAWT01 | Hawthorne and Carson | 12 | 0.24 | 0.8409 | 0.7920 | 5.64 | 2.17 | 47.2 |

*Determined from FlowMaster